UNITED STATES MARINE CORPS
MARINE CORPS SYSTEMS COMMAND
2200 LESTER STREET
QUANTICO, VIRGINIA 22134-5010

IN REPLY REFER TO:
5720
LAWQ
DON-USMC-2016-008342
2 Sep 16

SENT VIA EMAIL TO: chris.coxon@gsengineering.com
Mr. Christopher B. Coxon
47500 US Hwy 41
Houghton MI 49931

SUBJECT: DON-USMC-2016-008342

Dear Mr. Coxon:

This responds to your Freedom of Information Act/Privacy Act request dated July 26, 2016, which requests a copy of all test reports that were generated related to the Marine Corps Mine Roller System of rollers that have a 26" diameter tires that were fielded for the HMMWW platform.

The requested documents are enclosed.

Fees associated with processing your request are minimal and waived.

If at any time you are not satisfied that a diligent effort was made to process your request, you may file an administrative appeal with the Assistant to the General Counsel (FOIA) at:

Department of the Navy
Office of the General Counsel
ATTN: FOIA Appeals Office
1000 Navy Pentagon Room 4E635
Washington DC 20350-1000

For consideration, the appeal must be received in that office within 90 days from the date of this letter. Attach a copy of this letter and a statement regarding why you believe an adequate search was not conducted. Both your appeal letter and the envelope should bear the notation "FREEDOM OF INFORMATION ACT APPEAL". Please provide a copy of any such appeal letter to the MARCORSYSCOM address above.

Any questions concerning this matter should be directed to Mrs. Bobbie Cave at (703) 432-3934 or bobbie.cave@usmc.mil.

Sincerely,

Bobbie Cave

for Lisa L. Baker
Counsel

NAVAL SURFACE WARFARE CENTER
PANAMA CITY DIVISION
Panama City, Florida 32407-7001

PANAMA CITY GENERATION III MINE ROLLER SYSTEM GOVERNMENT VERIFICATION TEST REPORT

REVISION A

J. S. LOTURCO, CODE E41

USMC MANEUVER SYSTEMS BRANCH, CODE E27

NAVAL SURFACE WARFARE CENTER PANAMA CITY DIVISION

13 DECEMBER 2010

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13. SUPPLEMENTARY NOTES		
14. ABSTRACT The objective of this Government Verification Testing (GVT) was to verify that the four configurations of the Panama City (PC) Generation (GEN) III Mine Roller System (MRS) met the requirements of the *Marine Corps Systems Command (MARCORSYSCOM) Performance Specification for Mine Roller Systems*, dated 10 May 2010. The configurations tested were the GEN III 4x4, GEN III 4x4x4, GEN III 5x5, and the GEN III Scout 4x4. This was to be accomplished by conducting a receipt inspection of each configuration to verify basic required MRS attr butes and parameters, and by subjecting each configuration to a series of tests to verify conformance with the performance specification requirements.		
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a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			J. S. LoTurco
U	U	U	SAR		**20b. TELEPHONE NUMBER** (include area code) 850-234-4159

ABBREVIATIONS AND ACRONYMS

AFB	Air Force Base
AVTP	Allied Vehicle Testing Publications
CARC	Chemical Agent Resistant Coating
CM	Corrective Maintenance
COTS	Commercial Off-the-Shelf
CW	Continuous Wave
EME	Electromagnetic Environment
EPA	Environmental Protection Agency
EUMD	Essential Unscheduled Maintenance Demands
FX	Field Expedient
GVT	Government Verification Testing
HMMWV	High Mobility Multipurpose Wheeled Vehicle
IR	Infrared
JERRV	Joint Explosive Ordnance Rapid Removal Vehicle
J-PRIMES	Joint Preflight Integration of Munitions and Electronic Systems
LAV	Light Armored Vehicle
MARCORSYSCOM	Marine Corps Systems Command
M-ATV	Mine Resistant Ambush Protected (MRAP) All-Terrain Vehicle
MRAP	Mine Resistant Ambush Protected
MRIB	Mine Roller Interface Bracket
MRS	Mine Roller System
MSDS	Material Safety Data Sheet
MTTR	Mean Time To Repair
MTVR	Medium Tactical Vehicle Replacement
NATO	North Atlantic Treaty Organization
NSN	National Stock Number
NSWC PCD	Naval Surface Warfare Center Panama City Division
O	Objective

ABBREVIATIONS AND ACRONYMS (continued)

PC GEN III	Panama City Generation Three
PMCS	Preventive Maintenance Checks and Services
PPIED	Pressure Plate Improvised Explosive Device
SAR	Safety Assessment Report
T	Threshold
TV	Tactical Vehicle
UID	Unique Identification
UUNS	Universal Urgent Needs Statement
USMC	United States Marine Corp
VOIED	Victim Operated Improvised Explosive Device

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FIGURES (continued)

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EXECUTIVE SUMMARY

This test report documents the results of Government Verification Testing (GVT) of four configurations of a Mine Roller System (MRS) developed by the Naval Surface Warfare Center Panama City Division (NSWC PCD) in response to the United States Marine Corps (USMC) Universal Urgent Needs Statement (UUNS) (CDTS No. 01645UA). The four MRS configurations were evaluated per the requirements of the *Marine Corps Systems Command (MARCORSYSCOM) Performance Specification for Mine Roller Systems*, dated 10 May 2010.

Marine Corps Operating Forces conducting stability and sustainment operations in Afghanistan encounter a wide array of symmetrical and asymmetrical threats. Pressure activated explosive devices in the form of standard anti-tank mines and Victim Operated Improvised Explosive Devices (VOIEDs) pose a significant threat to forces utilizing light and medium tactical vehicles. The MRS is designed to reduce the impact of pressure activated explosive devices by causing them to function before the crew compartment of the wheeled vehicle passes over the device.

The four MRS configurations evaluated during this GVT, are the third generation variants of an MRS system originally developed by the USMC Maneuver Systems Branch of NSWC PCD. This variant is identified as the Panama City (PC) Generation (GEN) III MRS and incorporates enhanced mobility, performance, and modularity over former fielded variants. The configurations tested were the GEN III 4x4, GEN III 4x4x4, GEN III 5x5, and the GEN III Scout 4x4. The tactical vehicles (TVs) used were the High Mobility Multipurpose Wheeled Vehicle (HMMWV) and Medium Tactical Vehicle Replacement (MTVR).

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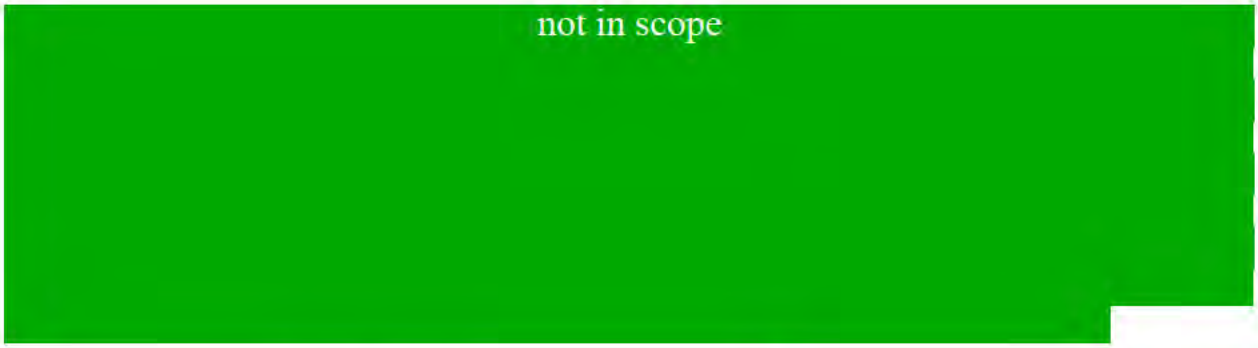
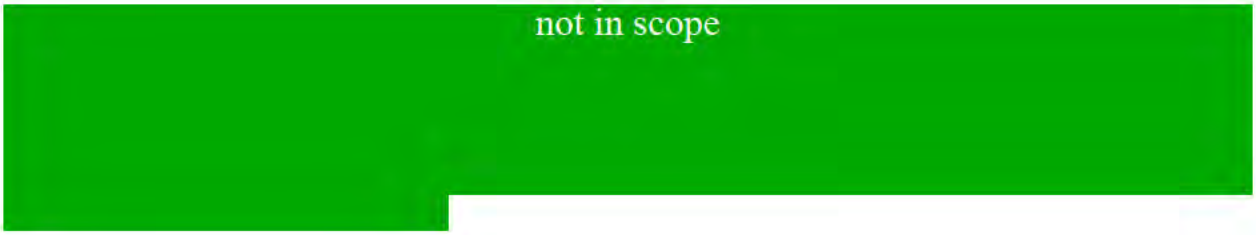




These test results are only valid for the TVs used. Further testing is recommended using other operational TVs (e.g., Mine Resistant Ambush Protected [MRAP] vehicles such as the Cougar).

1.0 INTRODUCTION

In response to the United States Marine Corps (USMC) Universal Urgent Needs Statement (UUNS) (CDTS No. 01645UA), the USMC Maneuver Systems Branch at the Naval Surface Warfare Center Panama City Division (NSWC PCD) has developed a Mine Roller System (MRS) to counter asymmetrical threats such as Pressure Plate Improvised Explosive Devices (PPIEDs) encountered by Marine Corps Operating Forces conducting stability and sustainment operations in Afghanistan. The MRS can be mounted on a variety of vehicles, including the High Mobility Multipurpose Wheeled Vehicle (HMMWV), Medium Tactical Vehicle Replacement (MTVR), and Mine Resistant Ambush Protected (MRAP) vehicles. These vehicles are commonly referred to as Tactical Vehicles (TVs). Depending on its configuration, the MRS can provide full-width or track-width coverage to protect the TV. The MRS can be used while traveling at tactical convoy speeds. The MRS was designed to activate PPIEDs before the host TV passes over the device, thereby reducing the impact of the explosion to the TV.

This report provides the results from Government Verification Testing (GVT) of four configurations of the Panama City (PC) Generation (GEN) III MRS developed by NSWC PCD. The configurations tested were the GEN III 4x4, GEN III 4x4x4, GEN III 5x5, and the GEN III Scout 4x4. The GVT was conducted at facilities and ranges located at Eglin Air Force Base (AFB), Florida.

1.1 Objectives

The objective of this GVT was to verify that the four configurations of the PC GEN III MRS met the requirements of the *Marine Corps Systems Command (MARCORSYSCOM) Performance Specification for Mine Roller Systems*, dated 10 May 2010. This was to be accomplished by conducting a receipt inspection of each configuration to verify basic required MRS attributes and parameters, and by subjecting each configuration to a series of tests to verify conformance with the performance specification requirements.

1.2 Scope

The four configurations of the PC GEN III MRS were subjected to GVT IAW the requirements contained in Data Collection section of the GVT test plan. The GVT plan utilized the operationally representative terrains available at Eglin AFB to verify the specified system requirements. For the purposes of this testing, three of the PC GEN III MRS configurations were tested using an MTVR, while the PC GEN III Scout MRS was tested using an HMMWV. All testing followed an "incremental test buildup" technique to safely assess each parameter. Whether the parameter was speed of advance, terrain, or harshness of maneuver etc., there was no intentional testing to destruction of any equipment or hardware. All initial testing was conducted IAW procedures outlined in *NSWCPCD-PPIED-SOP-0001 Standard Operating Procedure for Effectiveness Testing Against Surrogate Pressure Plate Improvised Explosive Devices, NSWCPCD-MRS-SOP-0001 Standard Operating Procedures for Mine Roller System Static Configuration Testing,* and *NSWCPCD-MRS-SOP-0002 Standard Operating Procedures for Mine Roller System Mobility*.

1.3 Applicable Documents

The following documents are applicable to these test events:

(a) *Performance Specification for Mine Roller Systems*

(b) *Government Verification Test Plan for PC GEN III MRS*

(c) *Standard Operating Procedures for Mine Roller System Static Configuration Testing, NSWCPCD-MRS-SOP-0001*

(d) *Standard Operating Procedures for Mine Roller System Mobility, NSWCPCD-MRS-SOP-0002*

(e) *Standard Operating Procedure for Effectiveness Testing Against Surrogate Pressure Plate Improvised Explosive Devices, NSWCPCD-PPIED-SOP-0001*

(f) *Mine Roller System Environmental Conditions Test Report*

(g) *Panama City Generation III WW 5x5 Mine Roller System Ballistics Test Report*

(h) *Panama City Generation III Government Verification Testing Effectiveness Test Final Report*

(i) *Panama City Generation III Mine Roller Field Installation Manual*

(j) *Panama City (PC) Generation (GEN) III Mine Roller Systems (MRS) Safety Assessment Report (SAR)*

(k) *Helicopter Sling Load Pre-Certification Test Report*

(l) *North Atlantic Treaty Organization - Allied Vehicle Testing Publications-Edition 1 (NATO AVTP-1)*

1.4 Equipment Descriptions

1.4.1 not in scope

not in scope

not in scope

1.4.2 not in scope

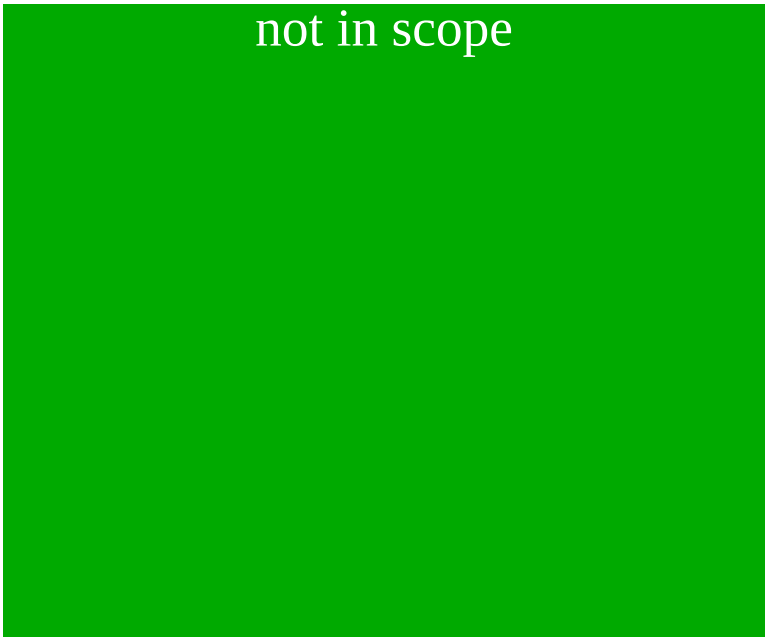
not in scope

not in scope

1.4.3 not in scope

not in scope

not in scope



1.4.4 PC GEN III MRS Scout

The PC GEN III MRS Scout configuration (Figure 1-6) evaluated for GVT consisted of a shortened, lightweight Roller Frame carrying a Front Modular Table with two wheel banks, each containing four 26-in. diameter foam-filled wheels (Drawing 39125-1. The four wheels of each bank were arranged in the staggered CJ4 arrangement. The Scout configuration of the PC GEN III MRS is a lightweight variant, containing no hydraulic steering equipment, designed to be used with an armored HMMWV, providing the TV with track width coverage.

Figure 1-6. PC GEN III MRS Scout

1.4.5 Mine Roller Interface Brackets

1.4.5.1 MTVR FX Bracket

The MTVR was equipped with an MTVR Field Expedient (FX) type (Figure 1-7) Mine Roller Interface Bracket (MRIB), which was used to attach the MRS to the vehicle.

Figure 1-7. MTVR FX MRIB

1.4.5.2 HMMWV FX Bracket

An HMMWV specific MRIB (Figure 1-8) was used to attach the MRS Scout to the vehicle.

Figure 1-8. HMMWV MRIB

1.4.6 not in scope

not in scope

not in scope

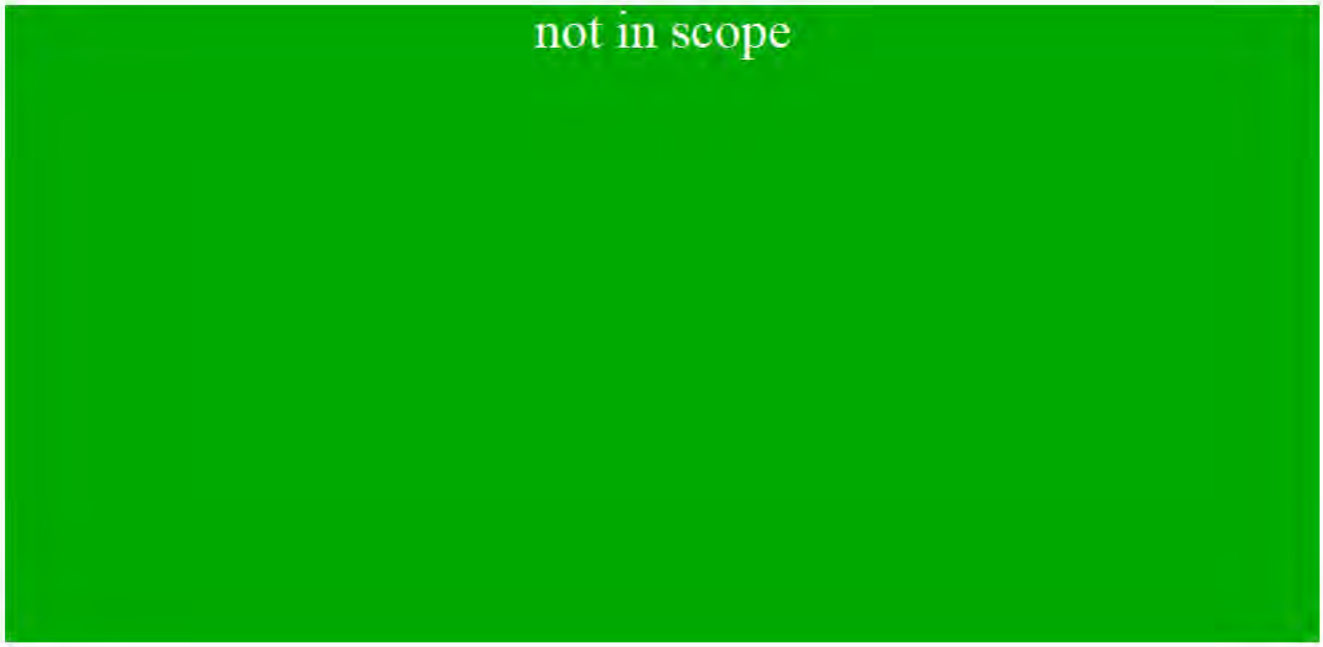
1.4.7 HMMWV

An armored M1116 HMMWV (Figure 1-10), featuring an expanded cargo area and an armored housing for a turret gunner, was used as the TV for GVT of the PC GEN III MRS Scout configuration. The HMMWV, fabricated by AM General, is a light, highly mobile, diesel-powered, four-wheel drive vehicle equipped with an automatic transmission.

Figure 1-10. M1116 HMMWV

1.5 not in scope

not in scope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2.0 GENERAL TEST INFORMATION

2.1 Government Verification Test Approach

To verify compliance with the requirements of the MRS Performance Specification, the GVT process included a thorough conformance inspection of each PC GEN III configuration, together with a series of tests and evaluations designed to verify TV interface and interoperability, system physical characteristics, operational environment survivability, critical design features, and performance thresholds of each MRS configuration. Conformance inspection results for each configuration are recorded on data sheets in Appendix A. Results of verification testing of each configuration are summarized on data sheets in Appendix B. Table 2-1 provides a cross reference of MRS performance requirements to the GVT results reported here.

Table 2-1. GVT Results Cross-Reference

MRS Performance Specification Requirement	MRS Spec. Section 3 Requirement	MRS Spec. Section 4 Method	GVT Results	Verification Methods A = Analysis D = Demonstration I = Inspection T = Test			
				A	D	I	T
Conformance Inspection	3.3	4.5	3.1		X	X	X
Mechanical Interface	3.5.1	4.7.1	3.2.1				X
Non-interference	3.5.2	4.7.2	3.2.2				X
Electrical Interface	3.5.3.1	4.7.3	3.2.3				X
Power Consumption	3.5.3.2	4.7.4	3.2.4				X
Gross Weight	3.6.1	4.8.1	3.3.1	X	X		X
Length, Width, Height	3.6.2	4.8.2	3.3.2	X	X		X
Temperatures	3.7.1	4.9.1	3.4.1	X	X		X
Rain/Blowing Rain	3.7.2	4.9.2	3.4.2	X	X		X
Humidity	3.7.3	4.9.3	3.4.3	X	X		X
Salt Fog	3.7.4	4.9.4	3.4.4	X	X		X
Blowing Sand	3.7.5	4.9.5	3.4.5	X	X		X
Blowing Dust	3.7.6	4.9.6	3.4.6	X	X		X
Altitudes	3.7.7	4.9.7	3.4.7	X	X		X
Shock and Vibration	3.7.8	4.9.8	3.4.8	X	X		X
Icing/Freezing Rain	3.7.9	4.9.9	3.4.9	X	X		X
Attachment	3.8.1	4.10.1	3.5.1			X	X
Detachment	3.8.2	4.10.2	3.5.2			X	X
Steering	3.8.3	4.10.3	3.5.3				X
Steering Lockout	3.8.4	4.10.4	3.5.4				X
Driving Lights	3.8.5	4.10.5	3.5.5			X	X
Blast Protection	3.8.6	4.10.6	3.5.6			X	
Mechanical Protection	3.8.7	4.10.7	3.5.7			X	X
Color	3.8.8	4.10.8	3.5.8	X		X	

Table 2-1 GVT Results Cross-Reference (continued)

MRS Performance Specification Requirement	MRS Spec. Section 3 Requirement	MRS Spec. Section 4 Method	GVT Results	Verification Methods A = Analysis D = Demonstration I = Inspection T = Test			
				A	D	I	T
Watertight	3.8.9	4.10.9	3.5.9			X	X
Fording	3.8.10	4.10.10	3.5.10			X	X
Human Factors	3.8.11	4.10.11	3.5.11			X	
Safety	3.8.12	4.10.12	3.5.12			X	
Common Tools and Parts	3.8.13	4.10.13	3.5.13			X	X
Electromagnetic Environment	3.8.14	4.10.14	3.5.14			X	X
Workmanship	3.8.15	4.10.15	3.5.15			X	
Hydraulic System External Leakage and Cleanliness	3.8.16	4.10.16	3.5.16			X	X
Reliability	3.8.17	4.10.17	3.5.17	X			X
Maintainability	3.8.18	4.10.18	3.5.18	X	X		
Mean Time to Repair	3.8.18.1	4.10.18.1	3.5.19	X	X		
Maximum Time to Repair	3.8.18.2	4.10.18.2	3.5.20	X	X		
Preventative Maintenance Checks and Services	3.8.18.3	4.10.18.3	3.5.21		X	X	
Environmental	3.8.19	4.10.19	3.5.22	X			
Towing	3.8.20	4.10.20	3.5.23				X
Slinging Provisions	3.8.21	4.10.21	3.5.24	X	X		
Tie-down Provisions	3.8.22	4.10.22	3.5.25	X	X		
Identification and Marking	3.8.23	4.10.23	3.5.26			X	
Padeyes Marking	3.8.23.1	4.10.23.1	3.5.27			X	
Unique Identification (UID) Marking	3.8.23.2	4.10.23.2	3.5.28			X	
Mine Initiation	3.9.1	4.11.1	3.6.1	X			X
VOIED* Initiation	3.9.2	4.11.2	3.6.2	X	X		X
Road Surface Undulations	3.9.3	4.11.3	3.6.3			X	X
Area of Coverage	3.9.4	4.11.4	3.6.4	X		X	X
Clearance Speed	3.9.5.1	4.11.5	3.6.5			X	X
Transit Speed	3.9.5.2	4.11.5	3.6.6	X	X	X	X
Tactical Vehicle Degradation	3.9.6	4.11.6	3.6.7	X	X	X	X
Attachment	3.9.7	4.11.7	3.6.8				X
Detachment	3.9.8	4.11.8	3.6.9				X

*VOIED—Victim Operated Improvised Explosive Device

2.2 Test Descriptions/Procedures

2.2.1 MRS Conformance Inspections

Conformance inspections were conducted on each PC GEN III MRS configuration. The inspections included measurements collected for the purpose of design verification and conformance to required MRS physical attributes and parameters. Inspection data for each configuration is recorded on Conformance Inspection Sheets in Appendix A and includes the following: TV specifications including front wheel axle loadings, MRS standoff distances from the TV, MRS tongue loading on the TV, MRS roller torsion spring data, MRS wheel loading, MRS slewing characteristics, and MRS overall dimensions.

Note: Tongue weights are measured with the MRS wheel banks in the forward direction (i.e., when TV is in forward drive position, Figure 2-1), and in the reverse direction (i.e., when TV is in reverse drive position, Figure 2-2).

Figure 2-1. Wheel Banks In Forward

Figure 2-2. Wheel Banks In Reverse

2.2.2 Interface and Interoperability Tests

2.2.2.1 Mechanical Interface

Each MRS configuration was installed on a TV, equipped with its specific MRIB. A forklift was used to install the MRIB and Tow Bracket IAW the *Panama City Generation III Mine Roller Field Installation Manual.* The events were timed and the number of personnel required was noted.

2.2.2.2 Non-Interference

Once installed on a TV, each MRS configuration was evaluated to verify that it did not block access to the hood, doors, or windows of the host vehicle.

2.2.2.3 Electrical Interface

Each MRS configuration was mated electrically with its host TV 24-Vdc standard North Atlantic Treaty Organization (NATO) slave receptacle and proper grounding was verified. Each MRS was tested to verify that its power consumption (see Paragraph 2.2.2.4) for lighting and steering (if applicable) did not adversely affect the TV or its operators. Watertight integrity of the electrical system after fording was also examined.

2.2.2.4 Power Consumption

All four MRS configurations were evaluated for current draw to verify that the lights, controls, and other continuously operating equipment drew less than 40 A, and to verify that the hydraulic steering operations (as applicable) drew less than a maximum steady state intermittent current of 240 A (200 A intermittent plus 40 A continuous).

2.2.3 Physical Requirement Tests

2.2.3.1 Gross Weight

The gross weight of each MRS configuration was measured and recorded as was the weight of the associated MRIB. Each configuration was subjected to the tests in Paragraph 2.2.6.7 for TV degradation to verify that the MRS gross weight did not degrade the TV operational mobility by more than 25% (O), 50% (T).

2.2.3.2 Length, Width, Height

As part of receipt inspection, length, width, and height measurements of each MRS configuration were recorded. Each configuration was subjected to the tests in Paragraph 2.2.6.7 for TV degradation to verify that the MRS length, width, and height did not degrade the TV operational mobility by more than 25% (O), 50% (T). Field of view tests (both daytime and nighttime) were conducted to verify, through polar plots, that the MRS did not adversely obscure the vision of the TV crew.

2.2.4 Operational Environments Requirement Tests

2.2.4.1 Temperatures

Temperature tests were not conducted.

2.2.4.2 Rain/Blowing Rain

Rain/Blowing Rain tests were not conducted.

2.2.4.3 Humidity

Humidity tests were not conducted.

2.2.4.4 Salt Fog

The PC GEN III MRS 5x5 was subjected to exposure to salt fog per MIL-STD-810, Method 509.5 at the McKinley Climactic Chamber at Eglin AFB. The Salt Fog test was in accordance with MIL-STD-810, Method 509.5, Paragraph 4.5, with exposure at 24-h intervals alternating 24-h wet, 24-h dry for a total of 240 h. The MRS was then examined for the effects of corrosion, cycled through all its functional modes, and subjected to a standard set of operational mobility maneuvers.

2.2.4.5 Blowing Sand

Blowing Sand tests were not conducted.

2.2.4.6 Blowing Dust

Blowing Dust tests were not conducted.

2.2.4.7 Altitude

Altitude tests were not conducted.

2.2.4.8 Shock and Vibration

Shock and Vibration tests were not conducted.

2.2.4.9 Icing/Freezing Rain

Icing/Freezing Rain tests were not conducted.

2.2.5 Design Requirement Tests

2.2.5.1 Attachment

Each MRS configuration was attached entirely to the front of a host TV, using a vehicle-specific MRIB. The time required to attach to the TV and the number of personnel required were recorded.

2.2.5.2 Detachment

Each MRS configuration was detached from a host TV, using its integral free-standing support system (jack stands). The time required to detach from the TV and the number of personnel required were recorded.

2.2.5.3 Steering

The three MRS configurations (4x4x4, 4x4, 5x5) equipped with hydraulic steering were examined to verify that they could indeed be steered separately from the host TV using a dedicated controller.

2.2.5.4 Steering Lockout

A steering failure was simulated, on the three MRS configurations (4x4x4, 4x4, 5x5) equipped with steering, by disconnecting the hydraulic rams that provide wheel bank steering control. The MRS was then driven in reverse until the wheel banks could be aligned for installation of lockout bars that are provided with the system. The MRS was then driven

forward with the lockout bars in place to verify that the roller system could be driven in a fixed, straight-ahead position while remaining maneuverable enough to still operate safely at reduced capability.

2.2.5.5 Driving Lights

Each MRS configuration was examined for driving lights (both infrared [IR] and white) during receipt inspection, and the number of each type light was recorded. A nighttime lighting test was conducted with the MRS 5x5 and the MRS Scout configurations to verify that the driving lights (both infrared and white) provided sufficient light to allow the operator to operate the MRS safely during night operations. For the infrared lights, the TV operator was equipped with night vision goggles.

2.2.5.6 Blast Protection

To verify that the MRS incorporates design features that minimize the effects of the explosive blast overpressure and fragmentation to the host TV and its crew, a live fire explosive test was conducted on a PC GEN III MRS 5x5 on 15 April 2010. Results of that test are documented in *Panama City Generation III WW 5x5 Mine Roller System Ballistics Test Report*, dated 7 July 2010.

2.2.5.7 Mechanical Protection

During compliance inspections for each MRS configuration the presence of mud guards was noted, and their effectiveness at preventing rocks and debris from being thrown or propelled back toward host TV was evaluated while conducting standard Mobility Test Maneuvers. The effectiveness of the mud guards was evaluated on secondary roads (i.e., muddy terrain, rocky roads, and sandy roads) at speeds exceeding 25 mph. Effectiveness on improved roadways (e.g., hard packed clay, paved) was evaluated up to 45 mph.

2.2.5.8 Color

During receipt inspections for each MRS configuration, the color of all external steel components was examined (using a standard color chip) to verify that the color was Desert Tan, Number 33446 of FED-STD-595. Each MRS was examined to verify the absence of paint on all terminal wiring connections, instruction diagrams and plates, instrumentation, rubber, lubrication fittings, hoses, nozzles, insulation material and any other part whose operation or function would be adversely affected by paint. The paint surface was monitored during testing for adhesion and durability. Procedures for surface preparation, quality assurance and application of all Chemical Agent Resistant Coatings (CARCs) were analyzed for conformance to MIL-DTL 53072.

2.2.5.9 Watertight

To verify water tightness, each MRS configuration was subjected to a fording test (see Paragraph 2.2.5.10) and examined afterward for the effects of exposure to the operating environment. Hydraulic and electrical enclosures were examined for water intrusion. Lights and hydraulic systems were cycled and evaluated for proper function.

2.2.5.10 Fording

Each MRS configuration was subjected to a fording test, making several passes through a pond to a depth of 40–55 in. After the test, hydraulic and electrical enclosures were

examined for water intrusion, and lights and hydraulic systems were cycled to evaluate for proper function.

2.2.5.11 Human Factors

Each MRS configuration was inspected for human systems integration and ergonomics, verifying that all cables and hydraulic lines were labeled and easy to connect/disconnect, that all maintenance points were easily accessible, that all visual indicators and messages on the MRS were easy to read in all light conditions, and that all controls and displays were easy to locate and operate with minimal risk of error. Critical lifting issues were addressed, as was the ability of the TV operator to view the MRS and have awareness of the mine roller's position during all tactical maneuvers.

2.2.5.12 Safety

A safety assessment of the PC GEN III MRS was conducted in December 2009 using the methodology described in MIL-STD-882D to identify and list any system safety hazards. For GVT, the MRS was evaluated for any serious safety hazards. All wiring, grounding, and fusing was examined for compatibility with the host TV. The mechanical safety of hydraulic system (pressure relieve valves, generic caps, etc.) was assessed. The presence of wheel bank marker flags was noted. Pinching, binding, and lifting issues were assessed.

2.2.5.13 Common Tools and Parts

Each MRS configuration was attached and detached (Paragraphs 2.2.5.1 and 2.2.5.2) from its host TV without utilizing tools of any kind other than the jack stand supports built into the roller frame. The tools required for attachment/detachment (if any) were recorded.

2.2.5.14 Electromagnetic Environment

The MRS electrical components and harnesses (common to all four MRS configurations) were inspected to verify that they were fabricated using bonding, shielding, and grounding techniques necessary for the MRS to operate in the host TV's intended eletromagnetic environment (EME). The MRS components included the following:

- Universal Junction Box
- Hydraulic pump, motor, and two hydraulic cylinders
- Six white driving lights and two infrared lights
- Manual system controller
- NATO Slave power connection
- Associated cables and connections

These components were then tested in an anechoic chamber at the Joint Preflight Integration of Munitions and Electronic Systems (J-PRIMES) test facility at Eglin AFB. Two tests were conducted: one to determine if the electromagnetic emissions radiating from these MRS components were within the limits of MIL-STD-461F RE102 for Army/Navy Ground Systems, and the second test was to determine if these MRS components were susceptible to the radiated electromagnetic limits of MIL-STD-461F RS103 for Army/Navy Ground Systems.

2.2.5.14.1 RE102 Radiated Emissions

RE102 Radiated Emissions testing was conducted in the J-PRIMES Anechoic Laboratory to determine if an MRS, in a normal operational configuration, would exceed specific radiated limits set forth in MIL-STD-461F for Army/Navy ground systems. Testing was conducted for the 2-MHz to 18-GHz range, with 1½ min of continuous operation cycling the hydraulic pistons in and out, and a 3 min cool-down period. Maximum cycle time was 1 h with a 3-h cooling off period for hydraulic fluid, pistons, and motor. See the *Mine Roller System Environmental Conditions Test Report* dated 20 September 2010, for the full test setup details and data from this test.

2.2.5.14.2 RS103 Radiated Susceptibility

RS103 Radiated Susceptibility testing was conducted in the J-PRIMES Anechoic Laboratory to determine if an MRS, in a normal operational configuration, would be degraded by emissions radiated from another source within the limits set forth in MIL-STD-461F for Army/Navy ground systems. The MRS was subjected to both Continuous Wave (CW) and modulated (pulsed) radiated electric fields. Testing required an electric field ranging from 2 MHz to 18 GHz at 50 V/m to be radiated onto the MRS with 1½ min of continuous operation cycling the hydraulic pistons in and out, and a 3-min cool down period. Maximum cycle time was 1 h with a 3-h cooling off period, for hydraulic fluid, pistons, and motor. See the *Mine Roller System Environmental Conditions Test Report* dated 20 September 2010, for the full test setup details and data from this test.

2.2.5.15 Workmanship

Each MRS configuration was inspected for quality and workmanship. The MRS was examined for processing flaws such as cracks, overspray, sharp edges, deformations, and missing operations that would affect serviceability, functioning, operations, appearance, or safety. Extra attention was paid to determine that extraneous metal had been removed from cast or forged parts, and that no salvaged parts had been used in MRS assembly.

2.2.5.16 Hydraulic System Leakage/Cleanliness

Each MRS configuration was examined on a daily basis for external hydraulic system leakage to verify that it not exceed SAE J1176, class 3 under normal operations.

2.2.5.17 Reliability

A 1,000-mi endurance run with the PC GEN III MRS 5x5 was conducted over a variety of roadways to demonstrate overall MRS reliability of 80% using a “typical” mission time of 8 h. The MRS operating times for this 1,000-mi endurance run were recorded, along with any repair event and the time required to perform the repair. The 1,000-mi endurance run far exceeded the “typical” mission time of 8 h.

2.2.5.18 Maintainability

The MRS was inspected and all replaceable parts evaluated to determine if the system was maintainable using only the tools contained in the Marine Corps General Automotive Mechanics Tool Kit. Openings provided for access to grease fittings and other hydraulic/electrical service maintenance activities were evaluated for compatibility with SAE J185. The Preventive Maintenance Checks (Paragraph 2.2.5.21) used with the MRS were evaluated from the perspective of maintainability, and the Mean Time to Repair (MTTR)

(Paragraph 2.2.5.19), and the Maximum Time to Repair (Paragraph 2.2.5.20) during the testing cycle was also assessed.

2.2.5.19 Mean Time to Repair

A 1,000-mi endurance run with the PC GEN III MRS 5x5 was conducted over a variety of roadways to demonstrate that the MTTR for all Essential Unscheduled Maintenance Demands (EUMD) do not exceed 1 h. The MRS operating times for this 1,000-mi endurance run were recorded, along with any repair event and the time required to perform the repair.

2.2.5.20 Corrective Maintenance Max Time to Repair

A 1,000-mi endurance run with the PC GEN III MRS 5x5 was conducted over a variety of roadways. The MRS operating times for this 1,000-mi endurance run were recorded, along with any repair event and the time required to perform the repair. Corrective Maintenance (CM) events including the adjustment, removal, repair, reinstallation, and alignment of repairable parts, modules, subassemblies, or assemblies was noted.

2.2.5.21 Preventive Maintenance Checks and Services

Prior to each days testing, the MRS configuration under test was subjected to a functional inspection per the PC GEN III Mine Roller Pre/Post Mission Check Card from the *Panama City Generation III Mine Roller Field Installation Manual*. Preventive maintenance inspection of the MRS to ensure its continued readiness prior to operation was incorporated in this Pre/Post Mission Check Card. The time required to perform these inspections was recorded.

2.2.5.22 Environmental Compliance

An inspection and analysis of the MRS production drawing package was conducted to determine hazardous materials used in the manufacture, assembly, maintenance, or sustainment of the MRS, and to verify that all handling and use of hazardous materials was in accordance with all Environmental Protection Agency (EPA) requirements in effect at the time of production. Material Safety Data Sheets (MSDS) for any hazardous material in use were provided. Particular attention was directed to verify that none of the following was used with MRS: asbestos, lead, beryllium, radioactive materials, hexavalent chromium (electroplating and coatings), cadmium (electroplating), mercury, or other highly toxic or carcinogenic materials (as defined in 29 CFR 1910.1200), or any Class I and Class II Ozone Depleting Substances.

2.2.5.23 Towing

Each MRS configuration was attached to an MRS Tow Bracket mounted on the back of an MTVR using a forklift. The system was towed over improved roads for over 30 mi at speeds up to 30 mph. The time required to prepare and attach the MRS to the Tow Bracket was recorded, as was the time to detach it from the bracket. The times required to attach/detach the MRS Tow Bracket to the MTVR were also noted.

2.2.5.24 Slinging Provisions

A finite element analysis of the MRS lift points was conducted to verify conformance to MIL-STD-209. A Helicopter Sling Load Pre-Certification Test was conducted.

2.2.5.25 Tie-down Provisions

A finite element analysis of the MRS tie-down points was conducted to verify conformance to MIL-STD-209.

2.2.5.26 Identification and Marking

Each MRS configuration was inspected to verify the presence of a durable, corrosion resistant, metallic identification plate showing the manufacturer's model number, cage code, National Stock Number (NSN), serial number, date of manufacture, contractor's name, and contract number.

2.2.5.27 Padeyes: Towing, Slinging, and Tie-down Marking

Each MRS configuration was inspected to verify that all towing, slinging, and tie-down locations were properly marked.

2.2.5.28 Unique Identification Marking

Each MRS configuration was inspected to verify that a specific UID marking, machine-readable with common optical scanning devices, accompanied by the corresponding human readable markings (as defined in MIL-STD-130) was incorporated on each metal identification data plates. An evaluation was conducted to determine if the MRS had spare parts, secondary repairable items, items tracked by serial number, or consumables that needed to be marked with the UID.

2.2.6 Performance Requirement Tests

2.2.6.1 Probability of Mine Initiation

Each MRS configuration was to be evaluated for effectiveness against a VS1.6 anti-tank mine employed using standard subsurface emplacement methods in an improved (asphalt) road and unimproved road surfaces at speeds of 5 to 25 mph. VS1.6 actuating devices (VS1.6 without the explosive charge) were modified by installing a commercial off-the-shelf (COTS) micro-switch into the VS1.6 base plate to indicate activation. *NSWCPCD-PPIED-SOP-0001 Standard Operating Procedure for Effectiveness Testing Against Surrogate Pressure Plate Improvised Explosive Devices* was used for this evaluation.

2.2.6.2 Victim Operated Improvised Explosive Device Initiation

Each MRS configuration was evaluated for effectiveness against a VOIED employed using documented subsurface emplacement methods on both improved (asphalt) and unimproved roadways at speeds of 5 to 25 mph. Each MRS was evaluated for effectiveness against VOIEDs through a series of effectiveness test conducted against NSWC PCD surrogate PPIEDs. *NSWCPCD-PPIED-SOP-0001 Standard Operating Procedure for Effectiveness Testing Against Surrogate Pressure Plate Improvised Explosive Devices* was used for this evaluation.

2.2.6.3 Road Surface Undulations

Each MRS configuration was evaluated for the MRS ability to compensate for road surface undulations and for effectiveness against VOIEDs. Test were conducted on an unimproved roadway modified to have undulations spaced 4 ft horizontally peak-to-valley (8 ft between surrogate PPIEDs) and 4 in. deep. PPIEDs were placed in the valleys of the undulations for the purposes of these tests. *NSWCPCD-PPIED-SOP-0001 Standard Operating Procedure*

for Effectiveness Testing Against Surrogate Pressure Plate Improvised Explosive Devices was used for this evaluation.

2.2.6.4 Area of Coverage

The track of each MRS configuration was measured and compared with the track width of its host TV to verify that the MRS was capable of clearing a path at least equal to the track width of the host TV. A Solid Edge model was developed to evaluate the coverage area of each MRS with respect to all other applicable TVs in service.

2.2.6.5 Clearance Speed

As part of the standard Mobility Test Maneuvers (NSWCPCD-MRS-SOP-0002,), each MRS configuration was evaluated for proper operation and performance with its host TV while traveling at clearance speeds of 5–10 mph on unimproved roads, and 20–35 mph on improved roads.

2.2.6.6 Transit Speed

As part of the standard Mobility Test Maneuvers (NSWCPCD-MRS-SOP-0002), each MRS configuration was evaluated for its ability to transit with its host TV at speeds in excess of 10 mph on unimproved roads, and 45 mph on improved roads.

2.2.6.7 Tactical Vehicle Degradation

To verify that the MRS did not degrade the host TV's operational mobility by more than 50%, the following comparative test/evaluations were conducted: Curb-to-Curb Turn, T Junction Turn, Braking, and Double Lane Change. The following paragraphs describe these tests.

2.2.6.7.1 Curb-to-Curb Turn

In accordance with the standard Mobility Test Maneuvers (NSWCPCD-MRS-SOP-0002), using NATO AVTP-1 Section 03-30 Paragraph 4.1 for guidance, the minimum inside and outside curb-to-curb turning radii for the PC GEN III MRS 4x4x4, 5x5, and Scout configurations were determined. Note: The PC GEN III MRS 4x4 was not conducted because it has the same turning radius as the 4x4x4 configuration.

The TV/MRS was driven in a circle with the TVs steering wheel at maximum deflection and the MRS in the straight ahead position (zero slew). The TV/MRS was driven at a very low speed while test personnel manually marked the ground at the outer most point of the MRS wheels (i.e., Wheel 1 for right-hand turn, Wheel 8 or 10 for left-hand turn). The inner most point of the wheels on the aft-most axle of the TV (e.g., for MTVR: Wheel 6 for a right-hand turn, Wheel 5 for left-hand turn) were also marked. The marked points were then used to determine the center point of the turn, and the turning radii for the system were then measured (See Figure 2-3).

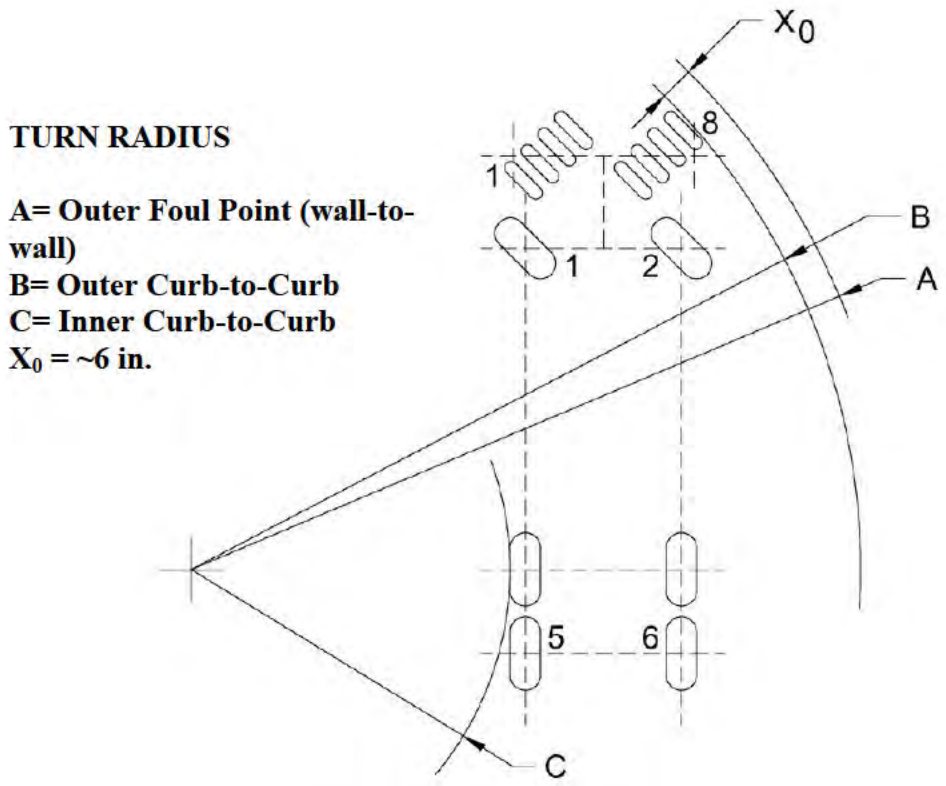


Figure 2-3. MRS Curb-to-Curb Test Diagram

The test was repeated on the 4x4x4 and 5x5 configurations with the MRS at full slew left in the left-hand turn, and full slew right in the right-hand turn.

The MRS was then disconnected from the TV and the test was repeated for the TV alone determining the minimum outside and inside turn radii of the TV (e.g., For MTVR: Wheels 1 and 6 in a right-hand turn, and Wheels 2 and 5 in a left-hand turn).

2.2.6.7.2 T-Junction Turn

Using NATO AVTP-1 Section 03-30 Paragraph 4.2 for guidance, the minimum road width required to negotiate a sharp 90° right (or left) hand turn was determined. Using the minimum curb-to-curb turning radius previously determined, a minimum road width was calculated per formula in the NATO AVTP-1, and a simple T-Junction course based on this minimum width dimension calculated was established (see Figure 2-4). The TV/MRS (in zero slew) then attempted to negotiate the T-Junction turn (both right-to-left and left-to-right) without shunting the course.

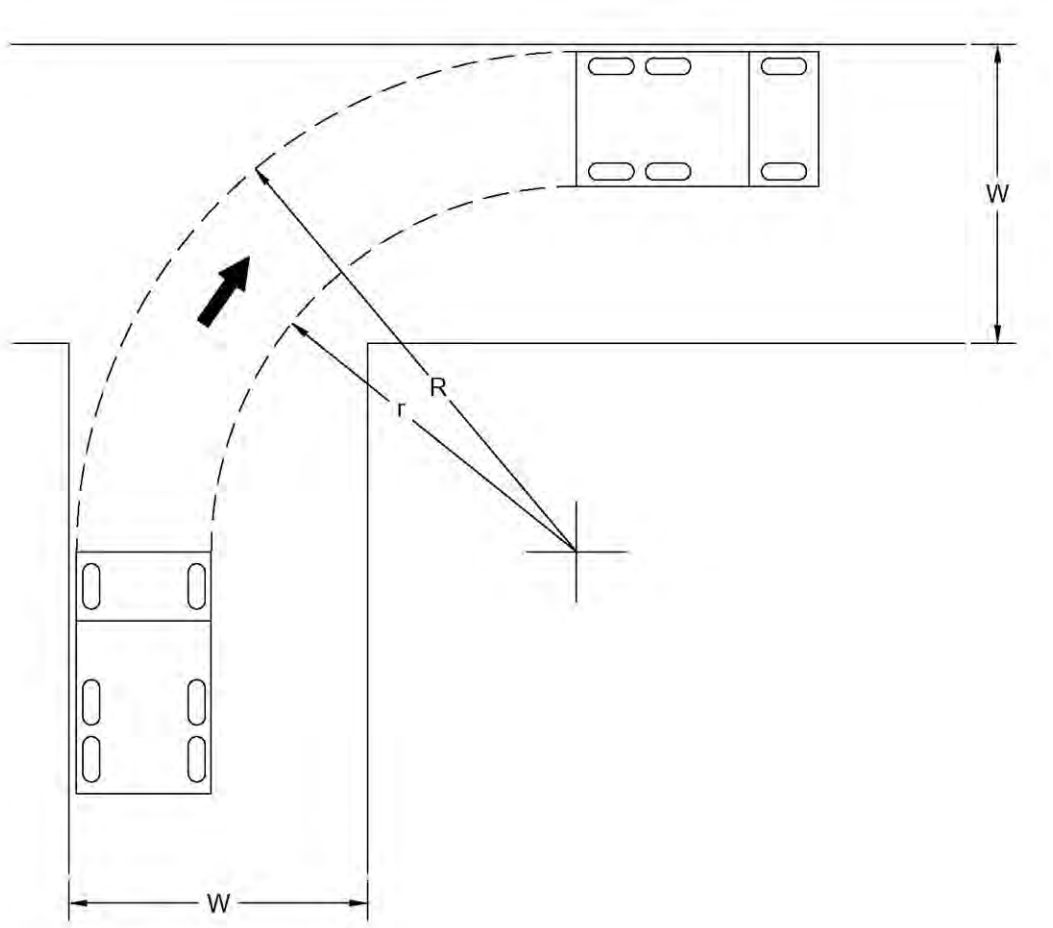


Figure 2-4. MRS T-Junction Test Diagram

2.2.6.7.3 Braking Test

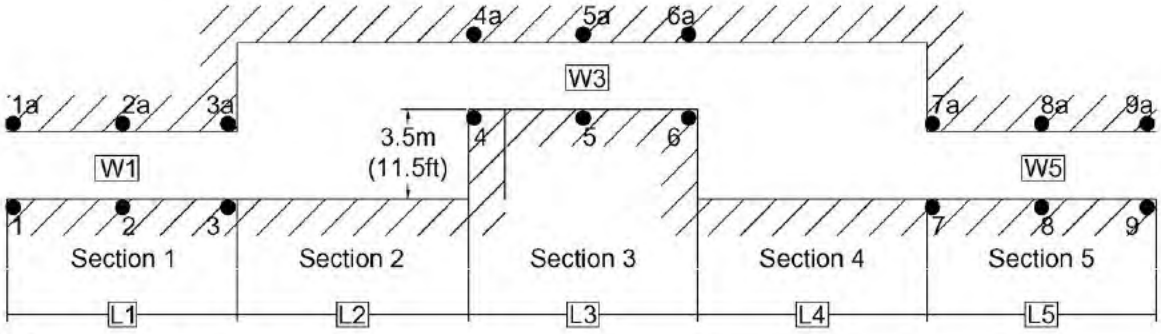
In accordance with the standard Mobility Test Maneuvers (NSWCPCD-MRS-SOP-0002), using Section 03-40 of the NATO AVTP-1 and TOP 2-2-608 as guidance, a comparison of braking distance was conducted. The distance required to brake was determined for a range of speeds (5, 10, 15, 20, 25, 30 and 35 mph). The distance required for the TV/MRS to reach a complete stop was determined three times at each speed, and the average stopping distance for that speed was recorded. The data was then compared against the average braking distance of the TV alone to determine the additional distance required to stop with MRS installed.

The test setup consists of placing two cones to mark the brake application point. A laser range finder was setup on a tripod well beyond any possible stopping point. A surveyor's prism was mounted on the hood of the TV. The initial distance (A) between the prism and the range finder was recorded. After stopping, the distance (C) between the prism and the range finder was also recorded. The difference between (A) – (C) = (B), was the stopping distance.

2.2.6.7.4 Double Lane Change

In accordance with the standard Mobility Test Maneuvers (NSWCPCD-MRS-SOP-0002), a Double Lane Change Test was conducted using the formulas in Section 03-160 of the NATO

AVTP-1 to established gate widths and the distances between gates for the test course. The NATO AVTP-1 formulas use the overall length and width of the vehicle (or TV/MRS) under test to determine these course dimensions. The overall lengths and widths of the PC GEN III MRS 4x4x4, 4x4, and 5x5 are similar and thus the Double Lane Change course for these three configurations was of similar size (see Figure 2-5). The Double Lane Change test was also conducted for the TV alone with the test course reconfigured using only the TV's dimensions.



Section 1 and Section 5

L1 = L5 = 15m = 590.6 in. = 49.2 ft
W1 = W5 = (1.1 x Vehicle Width) + 0.25m (1- in)
W (MTVR) = (1.1 x 96 in.) + 10 in. = 115.6 in = 9.6 ft
W (MTVR + MRS) = (1.1 x 133 in) + 10 in. = 156.3 in = 13.0 ft

Section 2 and Section 4

L2 = L4 = Overall Length of vehicle + 24m (944.9 in.)
L (MTVR) = 384 in. + 944.9 in. = 1328.9 in. = 110.7 ft
L (MRS) = (384 in. + 388 in.) + 944.9 in. = 1516.9 in. = 126.4

Section 3

L3 = 25m = 984.3 in = 82.0 ft
W3 = (1.2 x Vehicle Width) + 0.25m (10 in.)
W (MTVR) = (1.2 x 96 in.) + 10 in. = 125.2 in = 10.4 ft.
W (MRS) = (1.2 x 133 in.) + 10 in. = 169.6 in. = 14.1 ft

Section 1 and Section 5

Length of MRS = 188 in.
Width of MRS = 133 in.

Length of MTVR = 384 in.
Width of MTVR = 96 in.

Length of MTVR + MRS = 572 in.
Width of MTVR + MRS = 133 in.

Figure 2-5. Double Lane Change Test Diagram

2.2.6.8 Attachment

Each MRS configuration was attached to a host TV (with MRIB already installed) without the aid of material handling equipment or special tools other than the jack stands that are part of the MRS. No more than two personnel, excluding the TV driver, were used for attachment.

2.2.6.9 Detachment

Each MRS configuration was detached from its host TV without the aid of material handling equipment or special tools other than the jack stands that are apart of the MRS. No more than two personnel, excluding the TV driver, were used for detachment.

3.0 TEST RESULTS

Table 3-1 provides a summary overview of the GVT results. A more detailed narrative of the results of testing for each specification requirement is provided in the paragraphs below.

Table 3-1. MRS GVT Results Summary

Specification Requirement	Requirement Status	Comment
5.2.1 Mechanical Interface	MET	MRS easily mounted on TV without tools.
5.2.2 Non-interference	MET	MRS does not interfere with TV doors, windows, or hood.
5.2.3 Electrical Interface	MET	MRS meets all TV electrical interface requirements.
5.2.4 Power Consumption	MET	MRS meets TV power consumption requirements.
5.2.5 Gross Weight	MET	MRS gross weight does not overly affect TV performance.
5.2.6 Length, Width, Height	MET	MRS does not adversely obscure FOV of TV crew.
5.2.7 Temperatures	No Test	This test is not scheduled.
5.2.8 Rain/Blowing Rain	No Test	This test is not scheduled.
5.2.9 Humidity	No Test	This test is not scheduled.
5.2.10 Salt Fog	MET	Minor corrosion. Did not adversely affect MRS.
5.2.11 Blowing Sand	No Test	This test is not scheduled.
5.2.12 Blowing Dust	No Test	This test is not scheduled.
5.2.13 Altitudes	No Test	This test is not scheduled.
5.2.14 Shock and Vibration	No Test	This test is not scheduled.
5.2.15 Icing/Freezing Rain	No Test	This test is not scheduled.
5.2.16 Attachment	MET	MRS easily attached to TV.
5.2.17 Detachment	MET	MRS easily removed from TV.
5.2.18 Steering	MET With Exception	MRS 4x4x4, 4x4, 5x5 can be steered hydraulically. MRS Scout does not have hydraulic steering.
5.2.19 Steering Lockout	MET With Exception	MRS 4x4x4, 4x4, 5x5 steering can be locked. MRS Scout does not have hydraulic steering.
5.2.20 Driving Lights	MET	White and IR lighting adequate for night-time operation.
5.2.21 Blast Protection	MET	MRS 5x5 successfully tested.
5.2.22 Mechanical Protection	MET	MRS mud flaps protect TV from road debris.
5.2.23 Color	MET	All other color requirements met.
5.2.24 Waterproof	MET	MRS electrical and hydraulic systems are waterproof.
5.2.25 Fording	MET	MRS forded to 42 in. depth.
5.2.26 Human Factors	MET With Exception	MRS design not evaluated to MIL-STD-1472. All other requirements met.
5.2.27 Safety	MET	MRS meets safety requirements.
5.2.28 Common Tools and Parts	MET	No special tools required for TV attachment or removal.

Table Note: "Status" column is colored indicate preliminary finding:

Green = Met Yellow = Met w/Exception Red = Not Met

Table 3-1. MRS GVT Results Summary (continued)

Specification Requirement	Requirement Status	Comment
5.2.29 Electromagnetic Environment	NOT MET	Could not meet Radiated Emissions (RE102).
5.2.30 Workmanship	MET	MRS workmanship satisfactory.
5.2.31 Hydraulic System External Leakage and Cleanliness	MET	No leakage noted during performance testing or 1,000-mi endurance test.
5.2.32 Reliability	MET With Exception	No MRS repairs required during performance testing or 1,000- mi endurance. The 6,000-mi endurance not scheduled.
5.2.33 Maintainability	MET With Exception	No MRS repairs required during performance testing or 1,000- mi endurance. The 6,000-mi endurance not scheduled.
5.2.34 Mean Time to Repair	MET With Exception	No MRS repairs required during performance testing or 1,000- mi endurance. The 6,000-mi endurance not scheduled.
5.2.35 Maximum Time to Repair	MET With Exception	No MRS repairs required during performance testing or 1,000- mi endurance. The 6,000-mi endurance not scheduled.
5.2.36 Preventative Maintenance Checks and Services	MET With Exception	MRS pre-mission check card from Field Install Manual required average 35 min to complete.
5.2.37 Environmental	MET	No hazardous materials or ozone depleting substances used on MRS.
5.2.38 Towing	MET	MRS towed behind MTVR.
5.2.39 Slinging Provisions	MET	MRS lift points allow crane/helicopter lift.
5.2.40 Tie-down Provisions	NOT MET	MRS tie-down failed analysis. To be corrected with ECP.
5.2.41 Identification and Marking	MET	ID plate located on MRS Roller Frame.
5.2.42 Padeyes: Towing, Slinging, and Tie-down Marking	MET	All MRS towing, slinging, and tie-down padeyes marked.
5.2.43 Unique Identification Marking	MET	MRS IUD located on ID plate on Roller Frame.
5.2.44 Probability of Mine Initiation	NO TEST	Functioning surrogate targets not available.
5.2.45 Demonstration of Victim Operated Improvised Explosive Device (VOIED) Initiation	MET	MRS initiated PPIED on improved and unimproved roadways.
5.2.46 Road Surface Undulations	MET	MRS initiated PPIEDs on undulating unimproved roadway.
5.2.47 Area of Coverage	MET	MRS clears path equal to all TV track widths.
5.2.48 Clearance Speed	MET	MRS operates properly at specified clearance speeds.

Table 3-1. MRS GVT Results Summary (continued)

Specification Requirement	Requirement Status	Comment
5.2.49 Transit Speed	MET	MRS capable of transit at specified TV speeds.
5.2.50 Tactical Vehicle Degradation	MET	TV performance degraded less than 50% by MRS.
5.2.51 Attachment	MET	MRS attached to TV without aid of handling equipment.
5.2.52 Detachment	MET	MRS removed from TV without aid of handling equipment.

3.1 MRS Conformance Inspections

Data from Conformance Inspection of each PC GEN III MRS configuration can be found in Appendix A for the specific configuration. Conformance inspection of the PC GEN III MRS verified that each configuration met the required MRS physical attributes and design parameters. Each configuration provided adequate TV track width coverage, at the required standoff distances, with minimal additional TV front axle loading.

3.2 Interface and Interoperability Test Results

3.2.1 Mechanical Interface

Results of Mechanical Interface of each MRS configuration with its host TV/MRIB are recorded in Appendix B, Table B-1. All four configurations can be easily installed on their respective TV MRIB without the use of special tools or material handling equipment.

3.2.2 Non-Interference

Results verifying non-interference of each MRS configuration with its host TV are recorded in Appendix B, Table B-2. None of the MRS configurations interfered with access to the hood, doors, or windows of their host vehicles (Figure 3-1).

Figure 3-1. Non-Interference Inspection (MRS 4x4x4 and MTVR)

3.2.3 Electrical Interface

Each MRS configuration mated electrically with its host TV 24-Vdc standard NATO slave receptacle with no grounding issues. Power consumption of each MRS configuration was within the specification requirements for lighting and steering (if applicable), and did not adversely affect the TV or its operators. Each MRS configuration maintained adequate watertight integrity after fording, protecting the electrical system. Results of these tests for each MRS configuration are in Appendix B, Table B-3.

3.2.4 Power Consumption

Power consumption of each MRS configuration was within the specification requirements for lighting and steering (as applicable). Lights, controls, and other continuously operating equipment drew less than 40 A. Hydraulic steering operations (as applicable) drew less than a maximum steady state intermittent current of 240 A. Table 3-2 provides a summary of current draw for each configuration. Detailed results of these tests for each MRS configuration are in Appendix B, Table B-4.

Table 3-2. PC GEN III MRS Current Draw

MRS Configuration	IR Lights (A)	White Lights (A)	Full Slew Right (No Lights) (A)	Full Slew Left (No Lights) (A)	Full Slew Right (w/Lights) (A)	Full Slew Left (w/Lights) (A)
4x4x4	not in scope					
4x4						
5x5						
Scout	7.1	19.2	N/A	N/A	N/A	N/A

3.3 Physical Requirement Test Results

3.3.1 Gross Weight

The gross weight of the MRS configurations did not degrade their host TV operational mobility by more than 50% based on the results of the TV degradation evaluations (see Paragraph 3.6.7). Table 3-3 provides a summary of MRS gross weights. Results of gross weight measurements for each MRS configuration along with the weights of associated MRIBs can be found in Appendix B, Table B-5.

Table 3-3. PC GEN III Gross Weight Summary

MRS Configuration	4x4x4	4x4	5x5	Scout
Gross Weight (lb)	not in scope			4,420

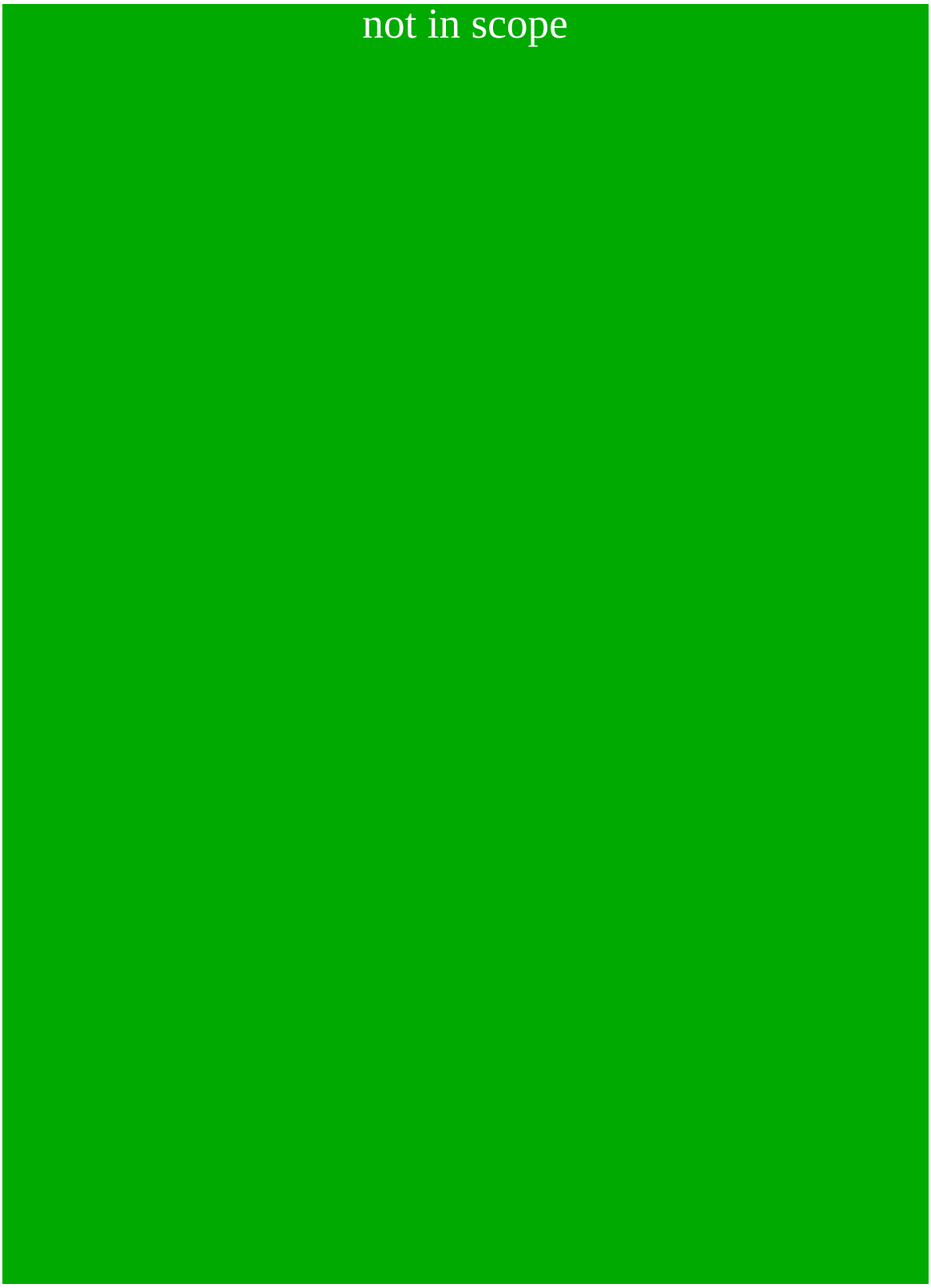
3.3.2 Length, Width, Height

The length, width, and height of each MRS configuration did not degrade the TV operational mobility by more than 50% based on the results of the TV degradation evaluations (see Paragraph 3.6.7). MRS lengths are shown in Figures 3-2 through 3-5. In general, the MRS did not adversely obscure the vision of the TV crew (see Figure 3-6).

Representative polar plots of operator field-of-view for the not in scope and Scout reveal the areas of added visual obstruction resulting from the MRS (see Figures 3-7 and 3-8). These data were taken in five-degree polar increments. not in scope Due to the low vantage point of the HMMWV operator, the MRS Scout obscures the forward field of view, by extending the blind area out 36-115% directly ahead of the MRS. Due to the fidelity of the polar plot data (i.e., data points at 5 degree increments) the light fixtures mounted on the MRS Front Modular Table did not factor into these nominal field-of-view profiles. The node points that these light fixtures represent would provide additional obstruction to the operator's line of sight at those node points (again see Figure 3-6).

Figures 3-9 and 3-10 illustrate the profile view of the difference in an operator's unobstructed viewing distance when looking straight ahead (at 0°). The profile fields-of-view are shown for the MTVR and for the HMMWV, with and without an MRS attached, to graphically show the field-of-view degradation when the MRS is attached. Figures 3-9 and 3-10 also illustrate the additional partial obstruction to operator field-of-view that would occur in line with a light fixture. Within the scope of this test, the six white lights and two infra-red (IR) lights were treated as a solid "bar" as shown in the profile views of Figures 3-9 and 3-10. Further testing is recommended employing smaller polar increments to better capture the smallest item that could affect the operator field-of-view.

A summary of results is presented in Appendix B, Table B-6.


not in scope

not in scope

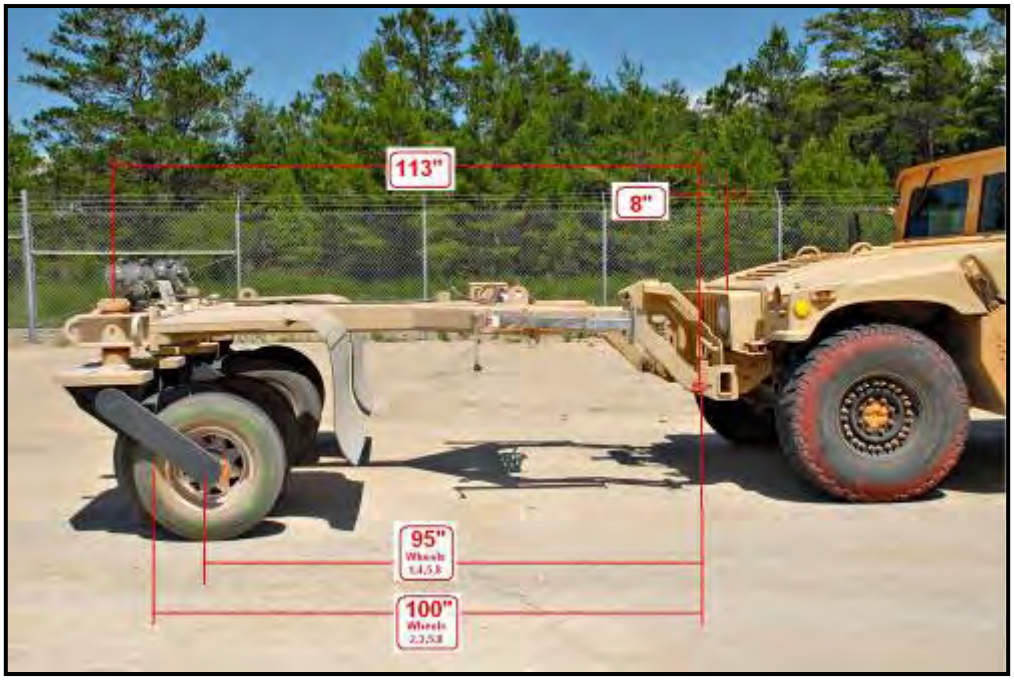
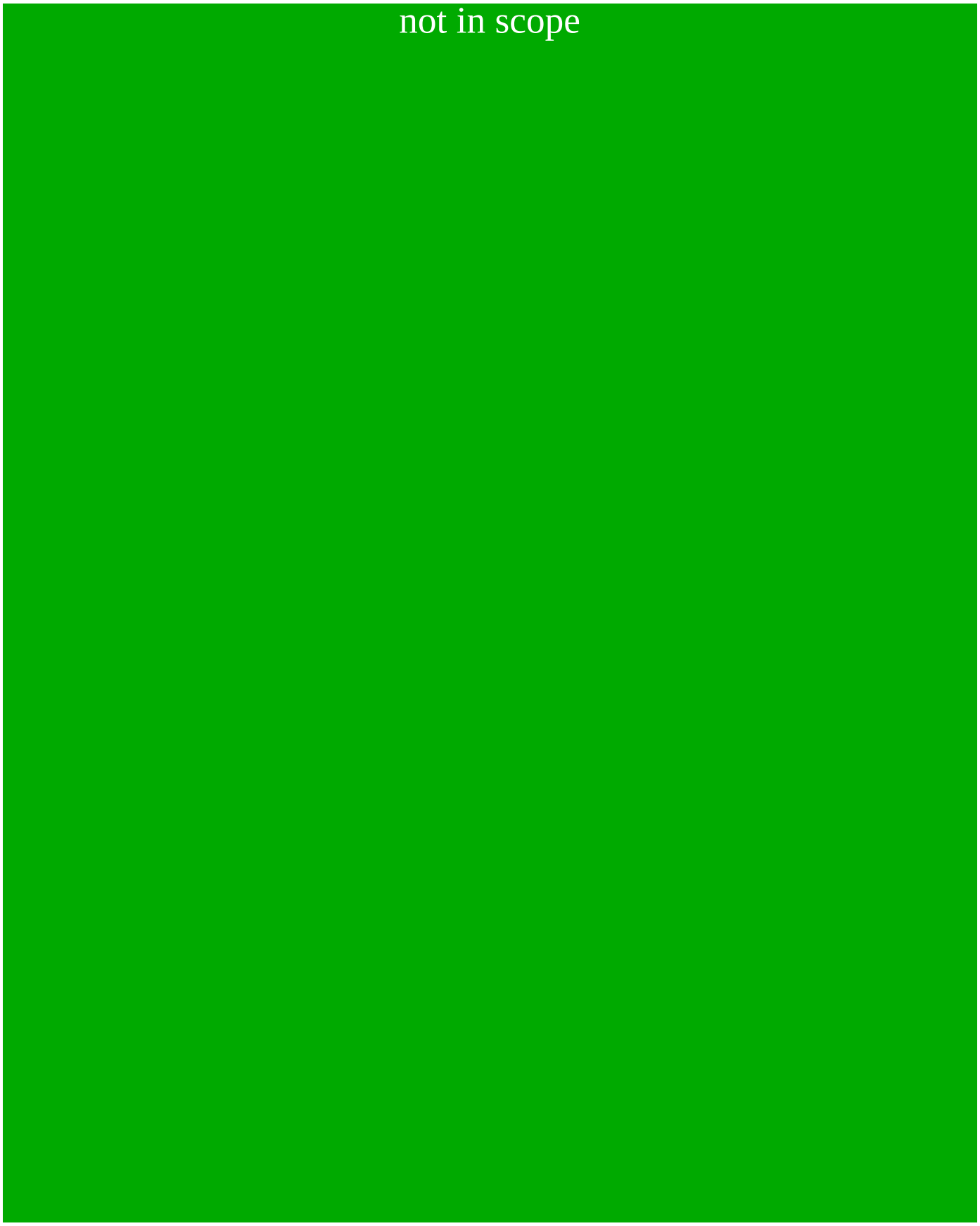


Figure 3-5. MRS Scout Lengths

Figure 3-6. Driver View from Tactical Vehicles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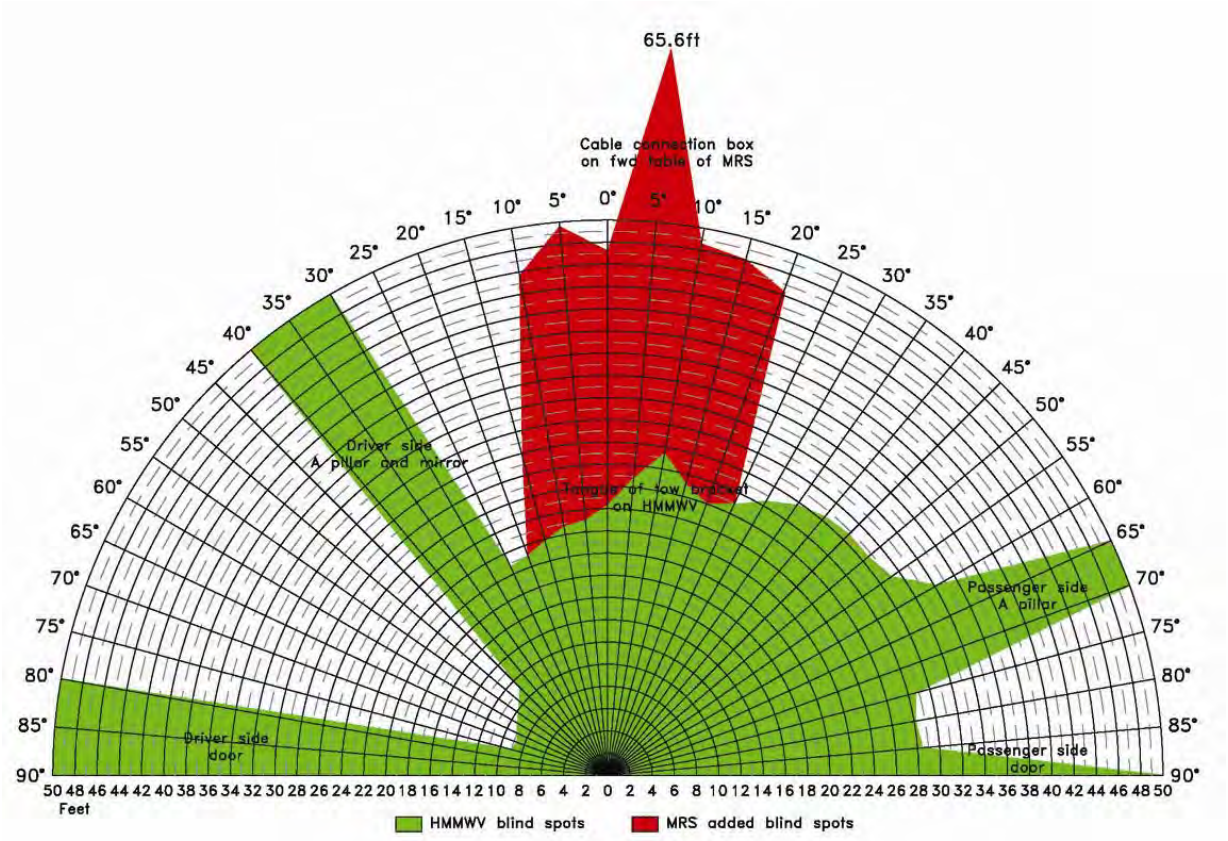
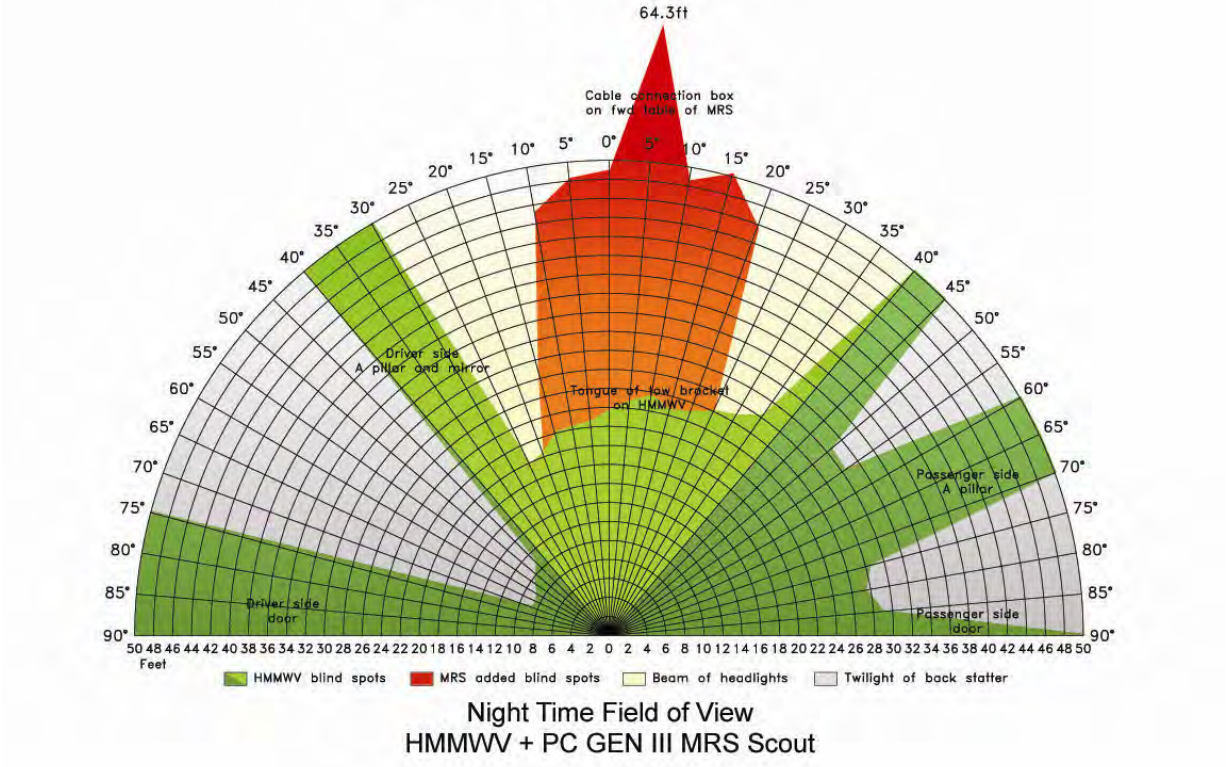


Day Time Field of View
HMMWV + PC GEN III MRS Scout



Night Time Field of View
HMMWV + PC GEN III MRS Scout

Figure 3-8. MRS Scout Field of View Polar Plots

not in scope

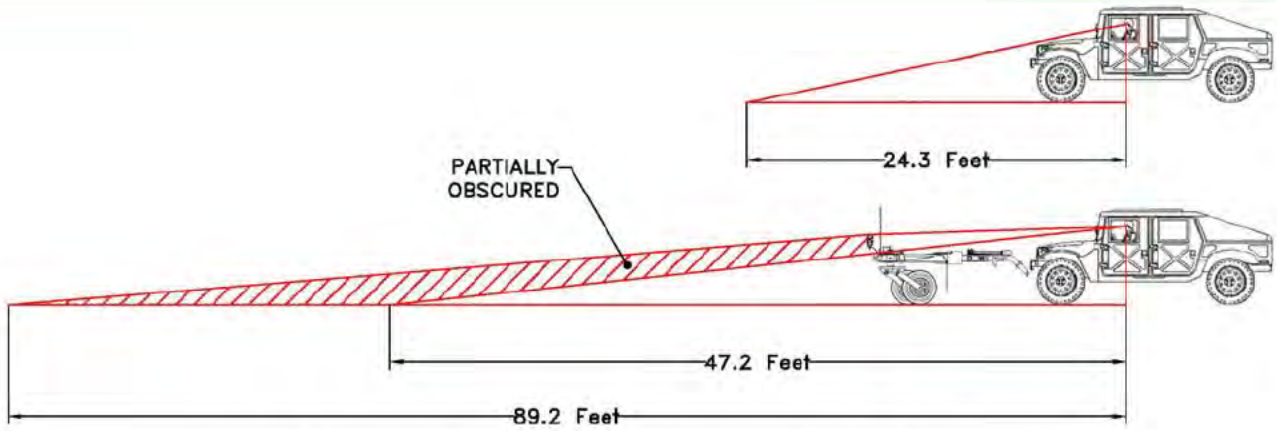


Figure 3-10. MRS Scout Daytime Operator Field of View

3.4 Operational Environmental Requirement Test Results

3.4.1 Temperatures

Temperature tests were not conducted.

3.4.2 Rain/Blowing Rain

Rain/Blowing Rain tests were not conducted.

3.4.3 Humidity

Humidity tests were not conducted.

3.4.4 Salt Fog

The PC GEN III MRS 5x5 subjected to exposure to salt fog per MIL-STD-810, exhibited minor surface corrosion that did not adversely affect its operational readiness. After salt fog exposure, the MRS was satisfactorily cycled through all its functional modes, and successfully completed a standard set of operational mobility maneuvers. Data for the post-salt fog mobility testing of the MRS 5x5 is in Appendix B, Table B-7, and can also be found in the *Mine Roller System Environmental Coditions Test Report*.

3.4.5 Blowing Sand

Blowing Sand tests were not conducted.

3.4.6 Blowing Dust

Blowing Dust tests were not conducted.

3.4.7 Altitude

Altitude tests were not conducted.

3.4.8 Shock and Vibration

Shock and Vibration tests were not conducted.

3.4.9 Icing/Freezing Rain

Icing/Freezing Rain tests were not conducted.

3.5 Design Requirement Test Results

3.5.1 Attachment

Each MRS configuration was successfully attached entirely to the front of a host TV, using the vehicle-specific MRIB. Results of this test for each MRS configuration are recorded in Appendix B, Table B-8.

3.5.2 Detachment

Each MRS configuration was successfully detached from a host TV, using its integral free-standing support system (jack stands). Results of this test for each MRS configuration are recorded in Appendix B, Table B-9.

3.5.3 Steering

not in scope

The MRS Scout configuration does not have a steering feature. not in scope .

3.5.4 Steering Lockout

not in scope

3.5.5 Driving Lights

not in scope The MRS 5x5 and Scout configurations were evaluated during night time operations, and provided more than sufficient light to allow for safe operation (see Figure 3-11). Results of the driving light test are summarized in Table 3-4 below, and recorded in Appendix B, Table B-12. not in scope

Figure 3-11. Driving Light Test

Table 3-4. MRS Light Test Results Summary

Methodology	MTVR w/ 5x5	HMMWV w/ Scout
1. Inspect for operational driving white lights.	not in scope	Yes - four centered at 46 in. above deck
2. Inspect for operational driving IR lights.		Yes- two
3. Baseline light spread pattern for white light test.		Light beams on all four lights pointed straight ahead and level.
4. Maximum visible distance that a target can be spotted with white lights.		Subject in dark clothes – 365 ft Subject in light clothes – 769 ft
5. Do white lights provide sufficient light to allow safe operation at night?		Yes - < 35 mph
6. Baseline light spread pattern for IR light test.		IR beams on both lights directed straight ahead.
7. Maximum visible distance that a target can be spotted from the IR lights.		Edge of IR beam at ~283 ft
8. Do IR lights provide sufficient light to allow safe operation at night with NVG?		Yes - < 35 mph

3.5.6 Blast Protection

not in scope

3.5.7 Mechanical Protection

The mudguards on each MRS configuration were effective at preventing rocks and debris from being thrown or propelled back toward host TV during the standard Mobility Test Maneuvers. Results for this test requirement for each MRS configuration are recorded in Appendix B, Table B-14.

3.5.8 Color

The color of all external steel components for each MRS configuration was verified to be Desert Tan, Number 33446 of FED-STD-595. Each MRS was free of paint on all terminal

wiring connections, instruction diagrams and plates, instrumentation, rubber, lubrication fittings, hoses, nozzles, insulation material and any other part whose operation or function would be adversely affected by paint. The paint surface on each MRS exhibited exceptional adhesion and durability. Proper procedures for surface preparation, quality assurance, and application of CARC coatings were found on MRS drawing documentation, and were in conformance with MIL-DTL 53072. Results for this test requirement are recorded in Appendix B, Table B-15.

3.5.9 Watertight

Each MRS configuration completed the fording test (see Paragraph 3.5.10) with minimal affect on operational ability. Some moisture was detected (less than 1 tsp) in the hydraulic box after submersion in the fording test, but it did not adversely affect the function of the system. All lights and hydraulic systems were cycled after fording, and operated properly. Results for this test requirement for each MRS configuration are recorded in Appendix B, Table B-16.

3.5.10 Fording

Each MRS configuration successfully completed the fording test, making several passes (two to three) through a pond to a depth of 40–55 in. (see Figure 3-12). After the test, all hydraulic/electrical enclosures were examined for water intrusion, and lights and hydraulic systems were cycled to evaluate for proper function. Though some moisture was noted in the hydraulic box, there was no adverse affect to the system operation. Results for this test requirement for each MRS configuration are recorded in Appendix B, Table B-17.

Figure 3-12. MRS Fording

3.5.11 Human Factors

Each MRS configuration was inspected for human systems integration and ergonomics. All cables and hydraulic lines were labeled and easy to connect/disconnect. All maintenance points and grease fittings were easily accessible. All visual indicators and messages on the MRS were easy to read in all light conditions. All controls and displays were easy to locate and operate with minimal risk of error. Some lifting issues associated with initial system assembly were noted. There were no were lifting issues associated with normal operations. Flags located on the wheel banks provide the TV operator an indication of the mine roller's

position during all tactical maneuvers. Results for this test requirement are recorded in Appendix B, Table B-18.

3.5.12 Safety

Any safety hazards identified in the *Panama City (PC) Generation (GEN) III Mine Roller Systems (MRS) Safety Assessment Report (SAR)* have been addressed and corrected. All MRS wiring, grounding, and fusing was found to be compatible with the host TV. The MRS hydraulic system (pressure relief valves, generic caps, etc.) was judged to be mechanically safe. Wheel bank marker flags, used to give the operator an indication of the mine roller's position during all tactical maneuvers, were present. No hazardous pinching, binding, or lifting issues were observed. Results for this test requirement are recorded in Appendix B, Table B-19.

3.5.13 Common Tools and Parts

Each MRS configuration was attached and detached from its host TV without utilizing tools of any kind other than the jack stand supports built into the roller frame. No more than two personnel (exclusive of vehicle driver) were required to attach or detach the MRS. A grease gun is the only tool provided with the MRS. Results for this test requirement are recorded in Appendix B, Table B-20.

3.5.14 Electromagnetic Environment

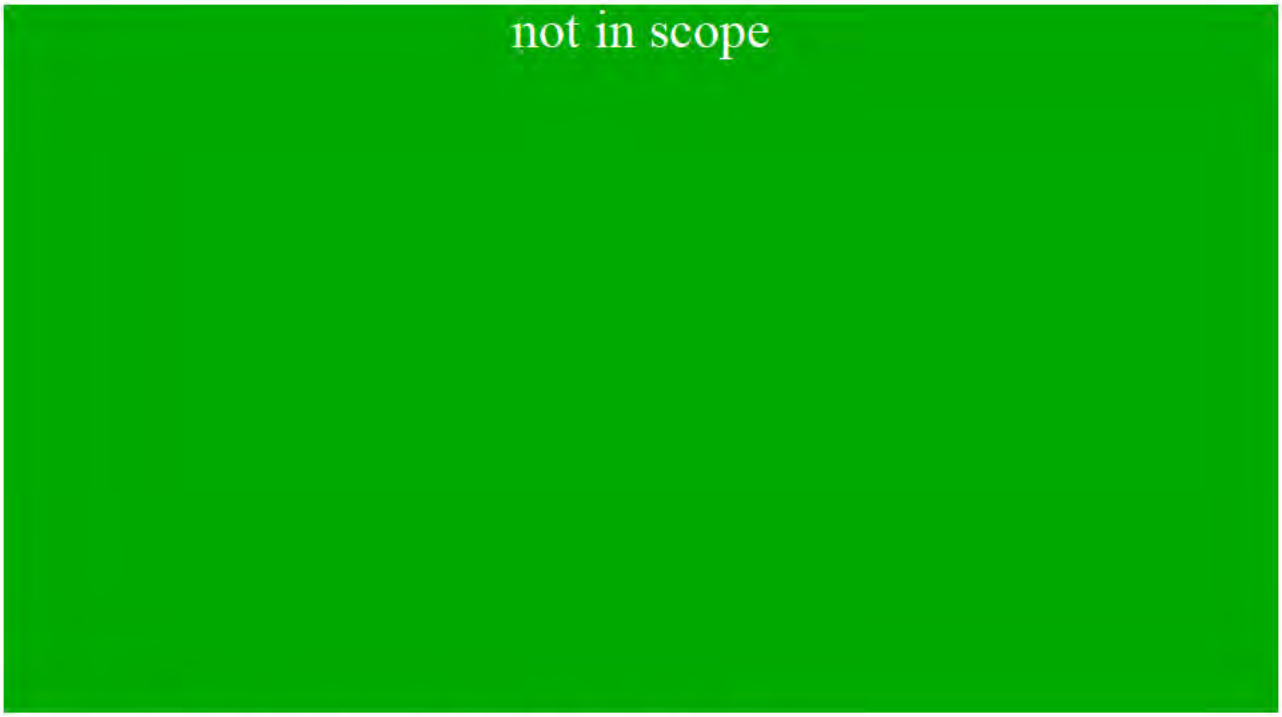
not in scope

Pass/Fail results for these tests are recorded in Appendix B, Table B-21. A more detailed discussion of the test results follows below.

3.5.14.1 RE 102 Radiated Emissions Results

The MRS passed radiated emission testing in two of three component tests (Table 3-5). Both the white lights and IR lights were successful in meeting radiated emission limits set forth by MIL-STD-461F.

not in scope



3.5.14.2 RS 103 Radiated Susceptibility Results

See the *Mine Roller System Environmental Conditions Test Report* dated 20 September 2010 for the full details and data from this test.

not in scope

3.5.15 Workmanship

All hardware for each MRS configuration was judged to be of high quality and fabricated to an acceptable level of workmanship. No processing flaws such as cracks, overspray, sharp edges, or deformations were noted. There was no indication of manufacturing short cuts or missing operations that would have affected serviceability, functioning, operations, appearance, or safety. There did not appear to be any salvaged parts used in MRS assembly. Results for this test requirement are recorded in Appendix B, Table B-22.

3.5.16 Hydraulic System Leakage/Cleanliness

No hydraulic leakage was noted for any of the MRS configurations during the GVT cycle. Results for this test requirement are recorded in Appendix B, Table B-23.

3.5.17 Reliability

No repairs were required of any MRS configuration during the regular GVT cycle.

not in scope

Results for this test requirement are recorded in Appendix B, Table B-24.

3.5.18 Maintainability

Daily inspection and Preventive Maintenance Checks revealed no damage requiring repair on any of the MRS configurations during the GVT cycle. Openings provided for access to grease fittings and for hydraulic/electrical service maintenance activities were judged to be acceptable. The MRS was easily maintained, with all work being accomplished using tools found in the Marine Corps General Automotive Mechanics Tool Kit. Results for this test requirement are recorded in Appendix B, Table B-25.

3.5.19 Mean Time to Repair

No repairs were required of any MRS configuration during the regular GVT cycle. not in scope esults for this test requirement are recorded in Appendix B, Table B-26.

3.5.20 Corrective Maintenance Max Time to Repair

No corrective maintenance was required of any MRS configuration during the regular GVT cycle. not in scope No adjustment, removal, repair, reinstallation, or alignment of any repairable parts, modules, subassemblies, or assemblies was required. Results for this test requirement are recorded in Appendix B, Table B-27.

3.5.21 Preventive Maintenance Checks and Services

Each MRS configuration under test was subjected to a daily functional inspection per the PC GEN III Mine Roller Pre/Post Mission Check Card from the *Panama City Generation III Mine Roller Field Installation Manual*. Following the steps on the Check Card, the inspection required 34–36 min to complete. This exceeded the 20-min. maximum requirement for a daily inspection. The same Check Card is used for preventive maintenance inspection of the MRS to ensure its continued readiness prior to operation. The 36-min required to complete the Check Card is well within the 2-h requirement for a preventive maintenance inspection. Results for this test requirement for each MRS configuration are recorded in Appendix B, Table B-28.

3.5.22 Environmental Compliance

An inspection of the MRS production drawing package revealed that no asbestos, beryllium, radioactive materials, hexavalent chromium (electroplating and coatings), cadmium (electroplating), mercury, or other highly toxic or carcinogenic materials (as defined in 29 CFR 1910.1200), or any Class I and Class II Ozone Depleting Substances was used in the manufacture of the MRS. not in scope . The handling and use of these hazardous materials are in accordance with all EPA requirements in effect at the time of production. Results for this test requirement are recorded in Appendix B, Table B-29.

3.5.23 Towing

Each MRS configuration was easily attached to/detached from an MRS tow bracket mounted on the back of a MTVR and made ready to tow in less than 15 min. Each configuration was

easily towed over improved roads (Figure 3-13) for over 30 mi at speeds up to 45 mph. Results for this test requirement for each MRS configuration are recorded in Appendix B, Table B-30.

Figure 3-13. Towing

3.5.24 Slinging Provisions

The finite element analysis of the MRS lift points confirmed that the lift points were of sufficient strength to meet the requirements of MIL-STD-209 and allow for a safe crane lift. A Helicopter Sling Load Pre-Certification Test conducted 16 June 2009 to confirm the analysis. The results of these tests are noted in Appendix B, Table B-31 and one also available in the *Helipoter Sling Load Pre-Certifcation Test Report*, dated 16 July 2009.

3.5.25 Tie-down Provisions

The finite element analysis of the MRS tie-down points revealed that the tie-downs were not of sufficient strength to meet the requirements of MIL-STD-209. The tie-down design is currently being revised and will be updated through the Engineering Change Process. The results of these tests are noted in Appendix B, Table 32.

3.5.26 Identification and Marking

Each MRS configuration was found to have a durable, corrosion resistant, metallic identification plate on the Roller Frame Assembly showing the manufacturer's model number, cage code, NSN, serial number, date of manufacture, contractor's name, and contract number. Results for this test requirement are recorded in Appendix B, Table 33.

3.5.27 Padeyes: Towing, Slinging, and Tie-down Marking

All towing, slinging, and tie-down locations on each MRS configuration were properly marked. Tow points were marked "TOWING". Sling points were marked "LIFT". Tie-down points were marked "NO LIFT". Results for this test requirement are recorded in Appendix B, Table B-34.

3.5.28 Unique Identification Marking

Each MRS configuration was found to have a specific UID marking, machine-readable with common optical scanning devices, accompanied by the corresponding human readable markings (as defined in MIL-STD-130). The UID was incorporated on each MRS metal identification data plate. MRS has no spare parts, secondary repairable items, items tracked by serial number, or consumables that needed to be separately marked with an UID. Results for this test requirement are recorded in Appendix B, Table B-35.

3.6 Performance Requirement Test Results

3.6.1 Probability of Mine Initiation

not in scope For further detail with a complete analysis, see *Panama City Generation III Government Verification Testing Effectiveness Final Report.*

Figure 3-14. VS1.6 Anti-Tank mine

3.6.2 VOIED Initiation

Each MRS configuration was evaluated for effectiveness against a VOIED through a series of effectiveness tests conducted against NSWC PCD surrogate PPIEDs IAW NSWCPCD *Standard Operating Procedure for Effectiveness Testing Against Surrogate Pressure Plate Improvised Explosive Devices* (NSWCPCD-PPIED-SOP-0001). The detailed test report with complete analysis is available in *Panama City Generation III Government Verification Testing Effectiveness Final Report.*

Tests were conducted at Eglin Range B-2, Auxiliary Field 4 during five different periods from 30 March 2010 to 10 September 2010. Testing was conducted on unimproved (Figure 3-15) and improved (Figure 3-16) road. Unimproved road tests were conducted using two different soil types (Test 1 and Test 2). Unimproved Road Test 1 was conducted in soil consisting primarily of red clay, but included dirt and rocks. Unimproved Road Test 2 was

conducted in soil consisting primarily of dirt and rock. Improved Road Test was conducted on an asphalt road approximately 20 years old.

Figure 3-15. Unimproved Road Test 2

Figure 3-16. Improved Road

not in scope

Target emplacement is described in the *Panama City Generation III Government Verification Testing Effectiveness Test Final Report*.

Effectiveness data is graphically presented as effectiveness versus speed. MTVR vs GEN III 4x4x4 , 4x4, and 5x5x data is presented first, HMMWV vs Scout data is presented second, and a comparative analysis is included.

3.6.2.1 Unimproved Road Test 1

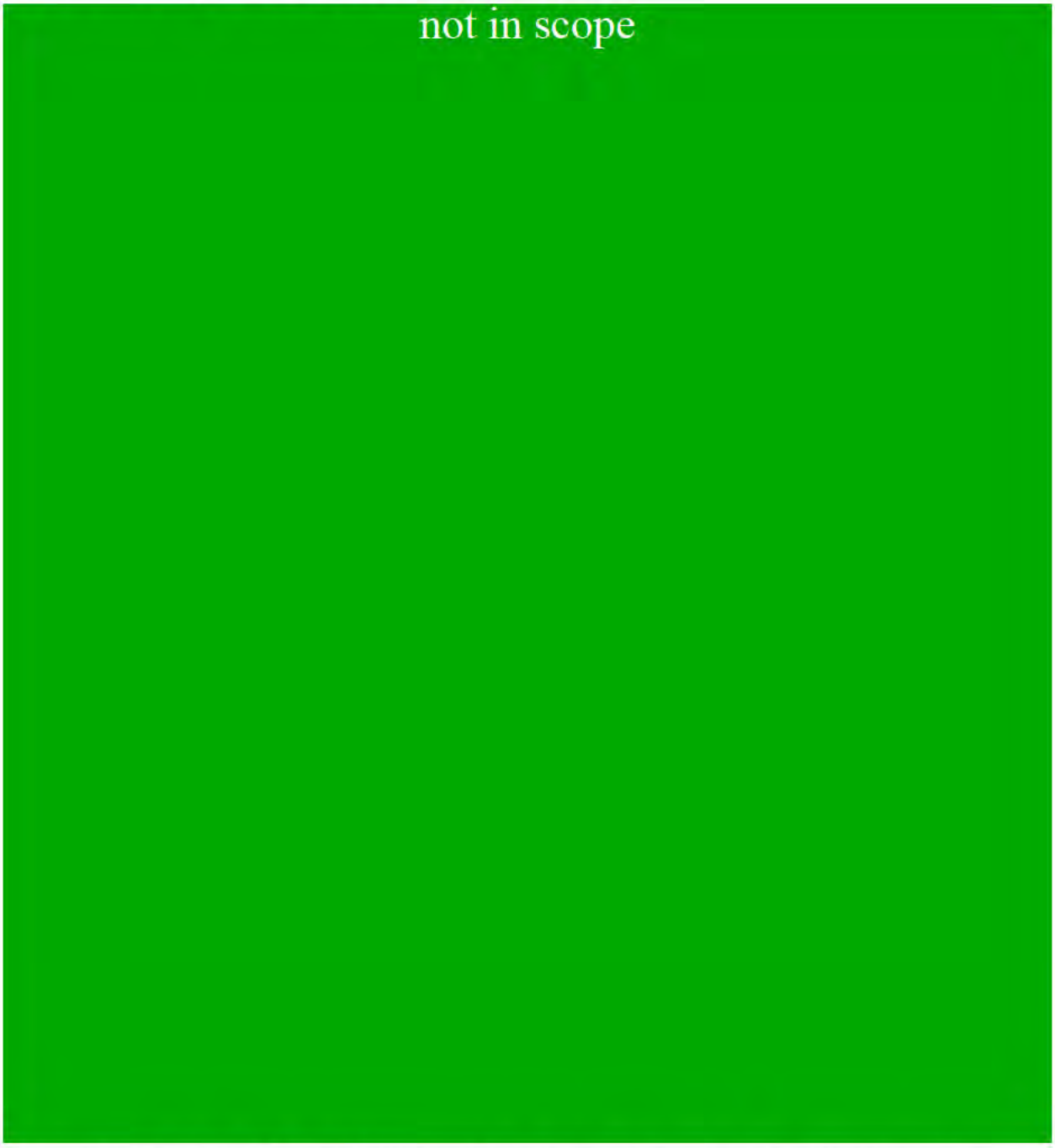


Figure 3-18 shows that the GEN III Scout 4x4 at no speed matches the effectiveness of the HMMWV. Comparing Figure 3-18 to Figure 3-17, it can be seen that the HMMWV was more effective than the MTVR at 5 mph, but slightly less effective than the PC GEN III 4x4.

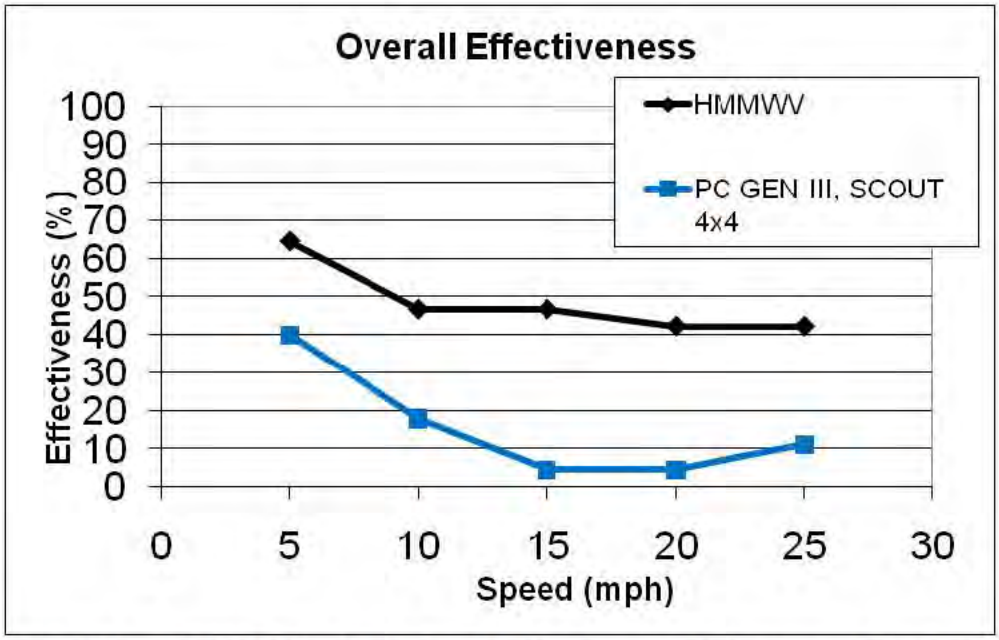


Figure 3-18. HMMWV vs MRS Scout Effectiveness Unimproved Road Test 1

3.6.2.2 Unimproved Road Test 2

not in scope

not in scope

not in scope

At 5 mph the HMMWV was 44% effective and the PC GEN III Scout 4x4 was 7% effective. The HMMWV steadily declined to 15% effectiveness at 15 mph and then steadily increased to 38% at 25 mph. The PC GEN III Scout 4x4 is reduced to 2% as speed increased to 15 mph and continues at this effectiveness for the remainder of the speeds. Comparing Figure 3-18 and Figure 3-20 shows that the HMMWV was comparable to the MTVR with better effectiveness at 5 and 25 mph, but worse effectiveness at 15 mph. It is important to note that reduced vehicle effectiveness is equal to reduced vulnerability. Further comparison shows that the PC GEN III, Scout 4x4 was only comparable to the other MRS at 15 mph or above.

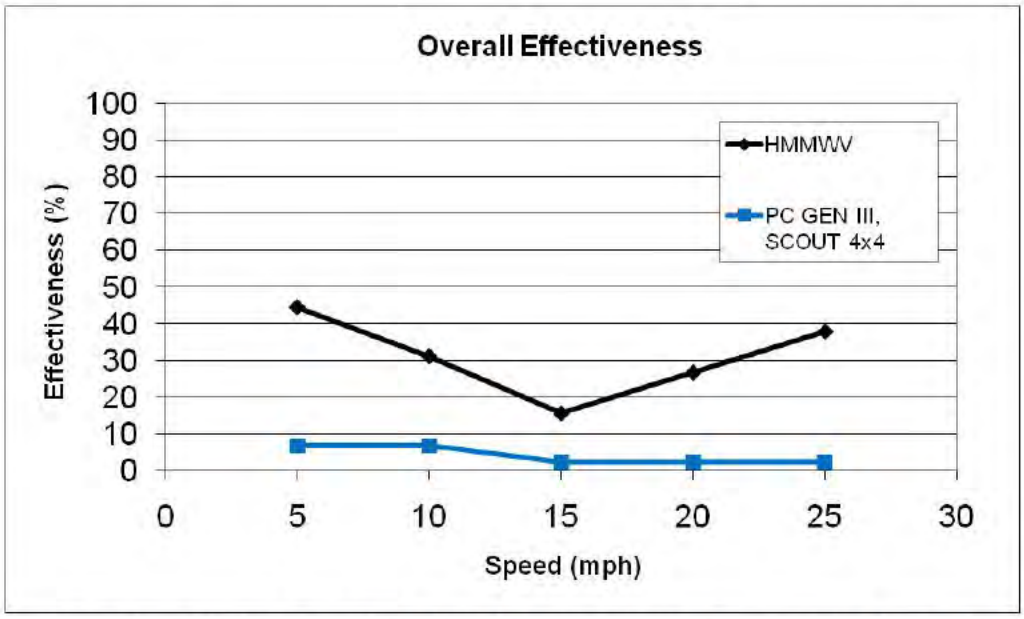


Figure 3-20. HMMWV vs MRS Scout Effectiveness Unimproved Road Test 2

3.6.2.3 Improved Road Test

not in scope

not in scope

As shown in Figure 3-20, the HMMWV and the PC GEN III Scout 4x4 exhibited similar effectiveness and were at averages of 15% and 14%, respectively.

not in scope

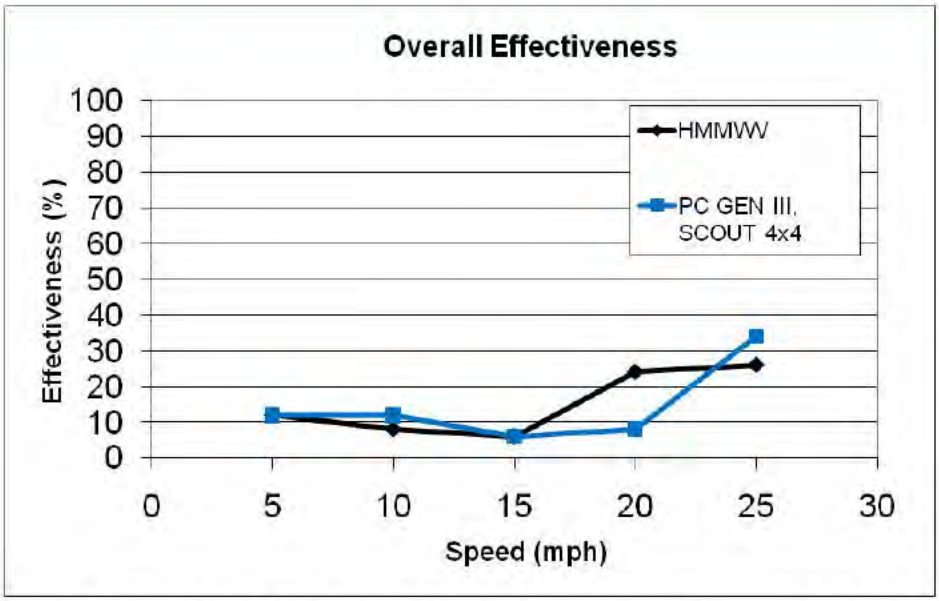


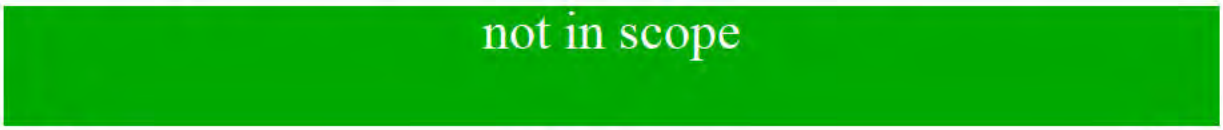
Figure 3-22. HMMWV vs MRS Scout Effectiveness Improved Road Test

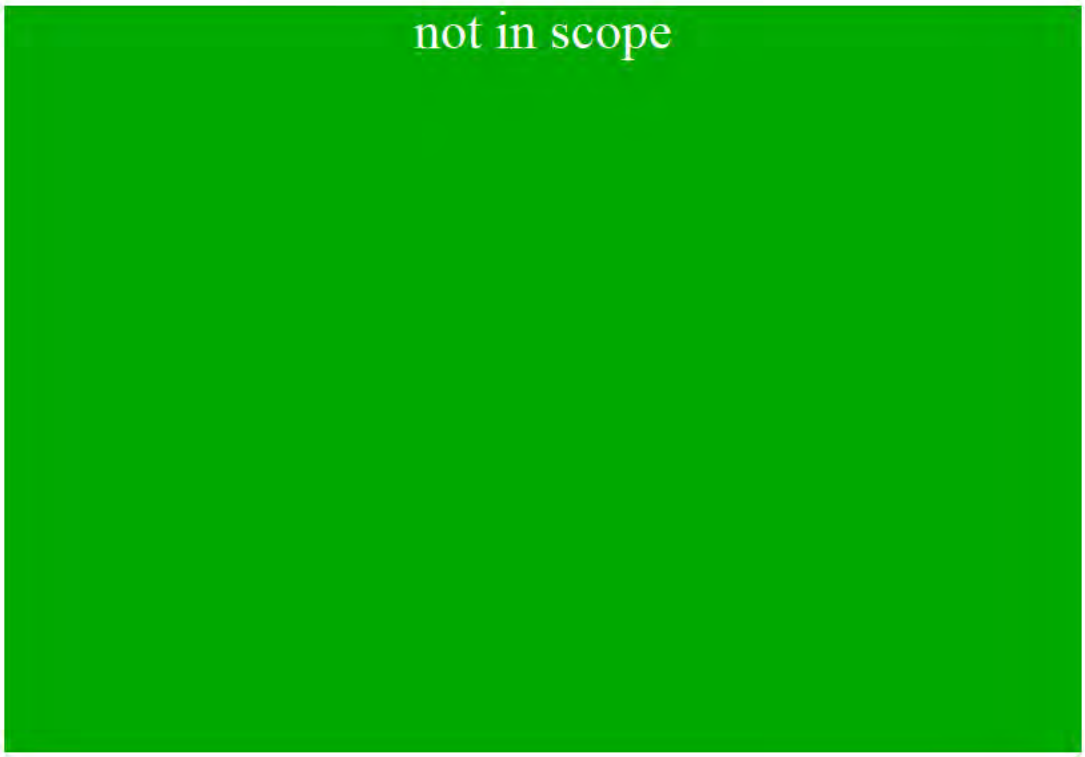
3.6.3 Road Surface Undulations

Each MRS configuration was evaluated for the MRS ability to compensate for road surface undulations and for effectiveness against VOIEDs through a series of effectiveness test conducted against NSWC PCD surrogate PPIEDs IAW NSWCPC *Standard Operating Procedure for Effectiveness Testing against Surrogate Pressure Plate Improvised Explosive Devices* (NSWCPCD-PPIED-SOP-0001). The detailed report of this test with complete analysis is available in *Panama City Generation III Government Verification Testing Effectiveness Test Final Report.*

Tests were conducted at Eglin Range B-2, Auxiliary Field. Test were conducted on an unimproved roadway modified to have undulations spaced 4 ft horizontally peak-to-valley (8 ft between surrogate PPIEDs) and 4 in. deep. PPIEDs were placed in the valleys of the undulations for the purposes of these tests.

Effectiveness data (Figure 3-23 and Figure 3-24) is graphically presented as effectiveness versus speed. MTVR vs GEN III 4x4x4 , 4x4, and 5x5 data is presented first. HMMWV vs Scout data is presented second, and a comparative analysis is included.





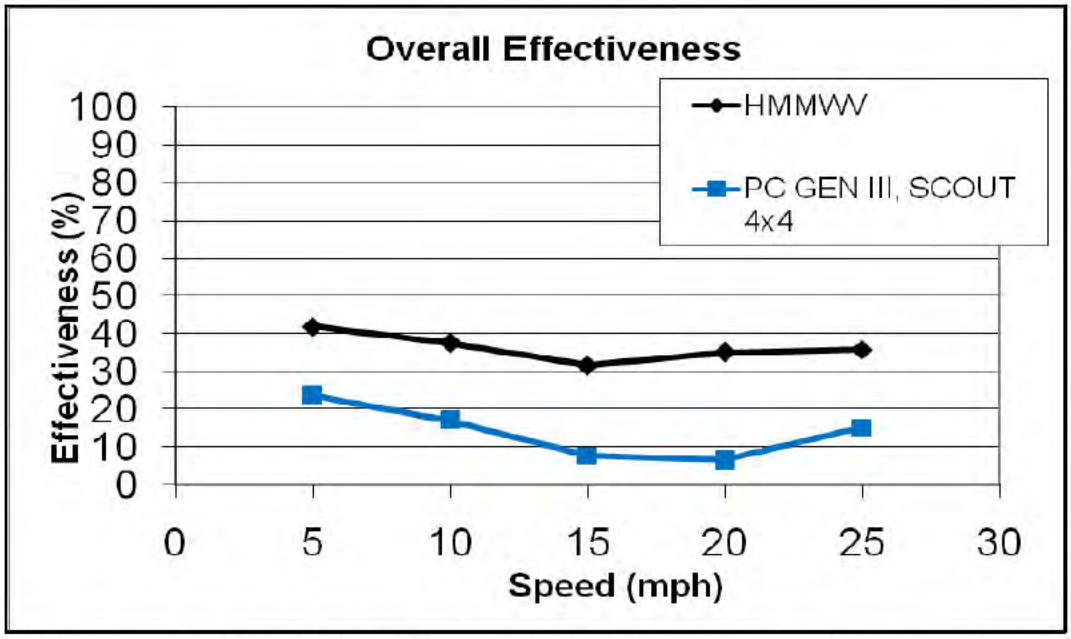


Figure 3-24. HMMWV vs MRS Scout Effectiveness—Undulating Terrain

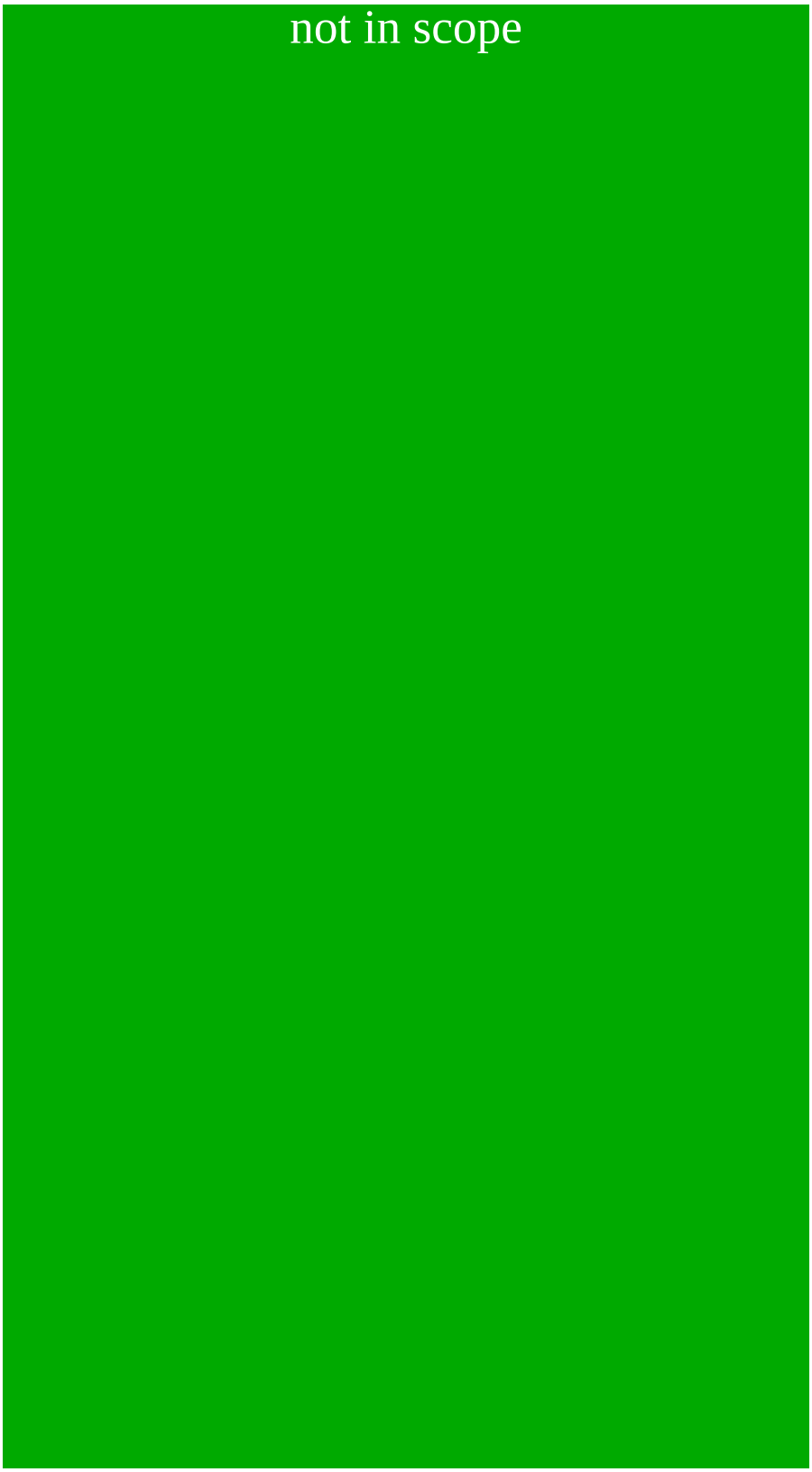
not in scope

3.6.4 Area of Coverage

Comparisons of the track of each MRS configuration with its host TV (see Table 3-8) verified that the MRS was capable of clearing a path at least equal to the track width of the host TV (see Figures 3-25 through 3-28). Solid Edge models were developed to evaluate the coverage area of each MRS with respect to all other applicable TVs in service. These models are available from NSWC PCD. Results for this test requirement for each MRS configuration are recorded in Appendix B, Table B-39.

Table 3-8. Area of Coverage Comparison

	MTVR	4x4x4	4x4	5x5	HMMWV	Scout
Outer Track Width (in.)	not in scope				81	118
Inner Track Width (in.)					61	33


not in scope

not in scope

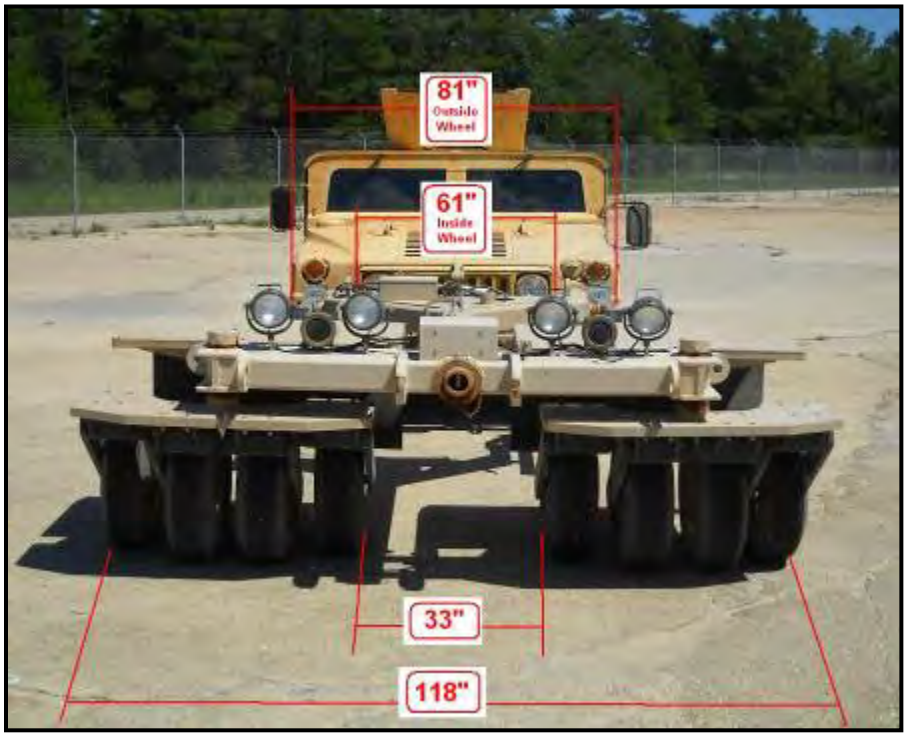


Figure 3-28. MRS Scout Area of Coverage

3.6.5 Clearance Speed

Mobility Test Maneuvers (NSWCPCD-MRS-SOP-0002) for each MRS configuration verified the proper operation and performance of the system with its host TV while traveling

at the specified clearance speeds of 5–10 mph on unimproved roads, and 20–35 mph on improved roads. Results for this test requirement for each MRS configuration are recorded in Appendix B, Table B-40.

3.6.6 Transit Speed

Mobility Test Maneuvers (NSWCPCD-MRS-SOP-0002) for each MRS configuration verified the system ability to transit with its host TV at speeds in excess of 10 mph on unimproved roads and 45 mph on improved roads. Results for this test requirement for each MRS configuration are recorded in Appendix B, Table B-41.

3.6.7 Tactical Vehicle Degradation

Results for the tests discussed below verified that the affect of each MRS configuration on the host TV's operational mobility did not degrade the TV mobility by more than 50%. The results for each MRS configuration are tabulated in Appendix B, Table B-42.

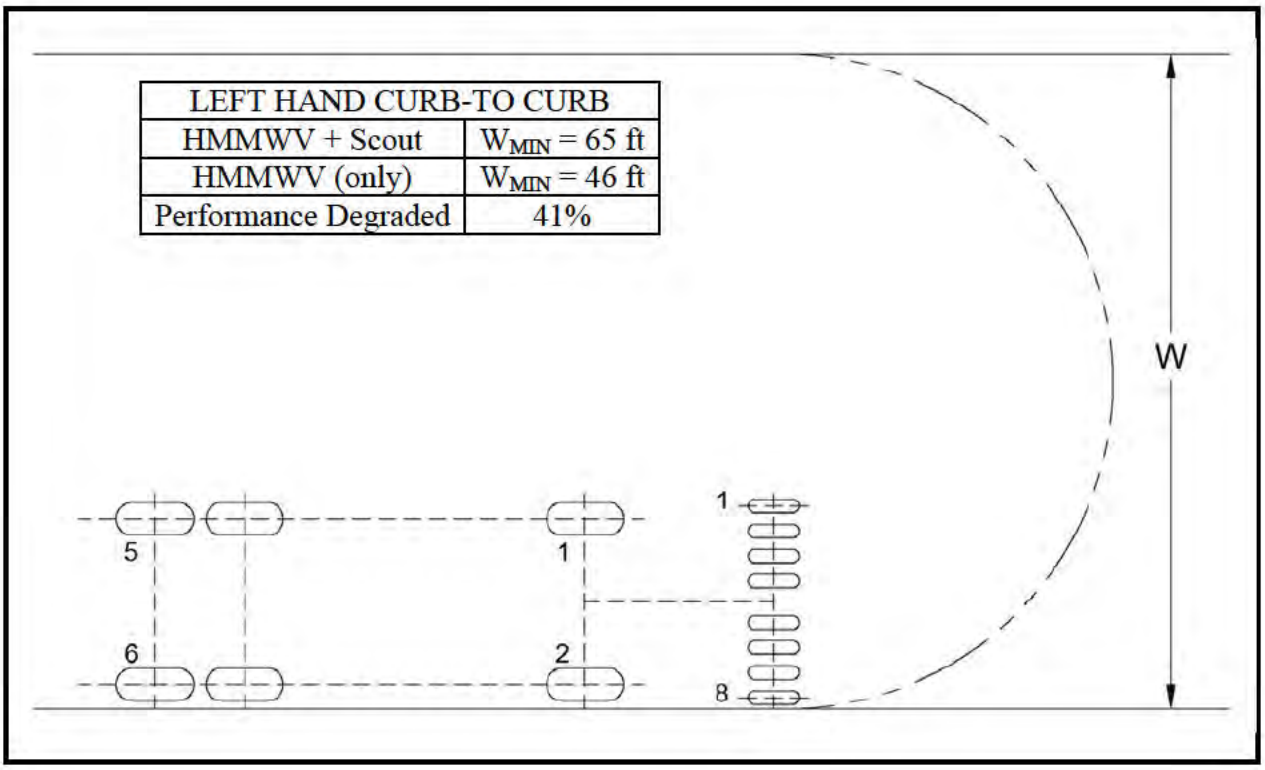
3.6.7.1 Curb-to-Curb Turn

not in scope

For the MRS Scout configuration, the curb-to-curb width required by the HMMWV was found to be 40–41% less than that required with the Scout attached (see Figure 3-31).

not in scope

not in scope



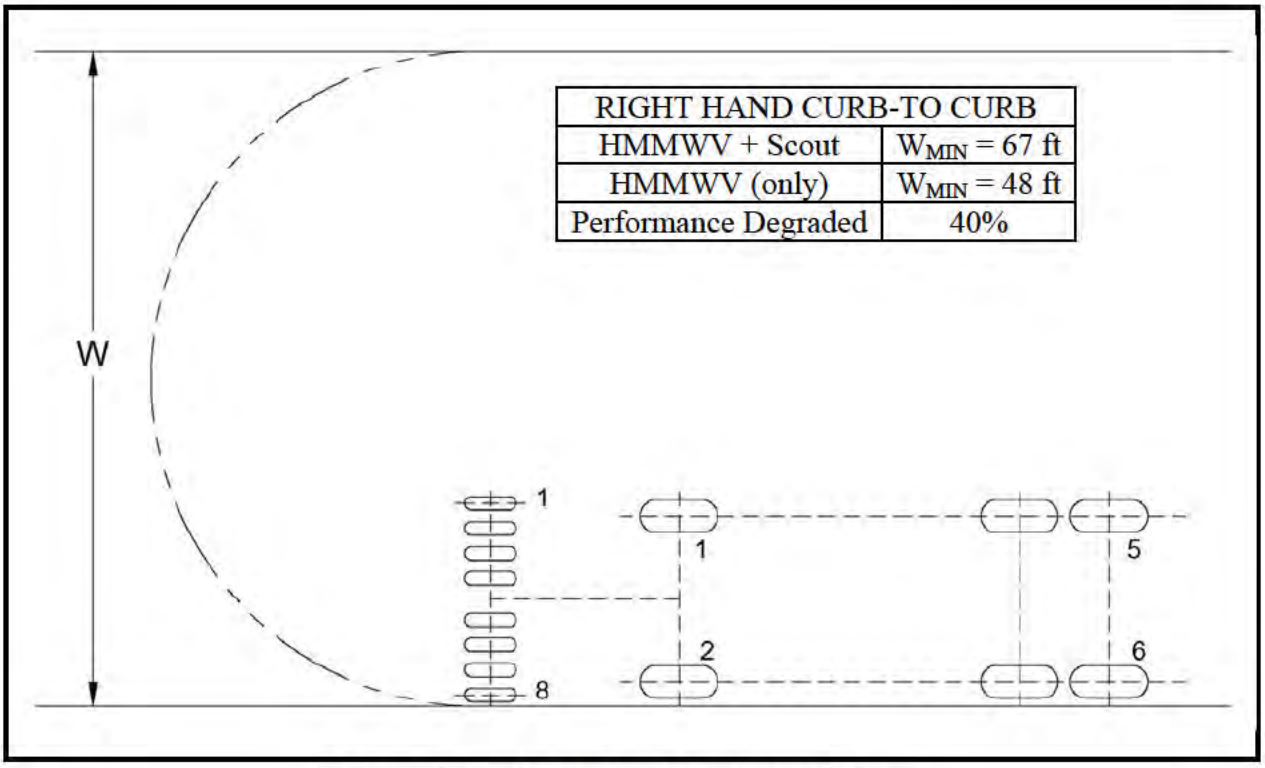
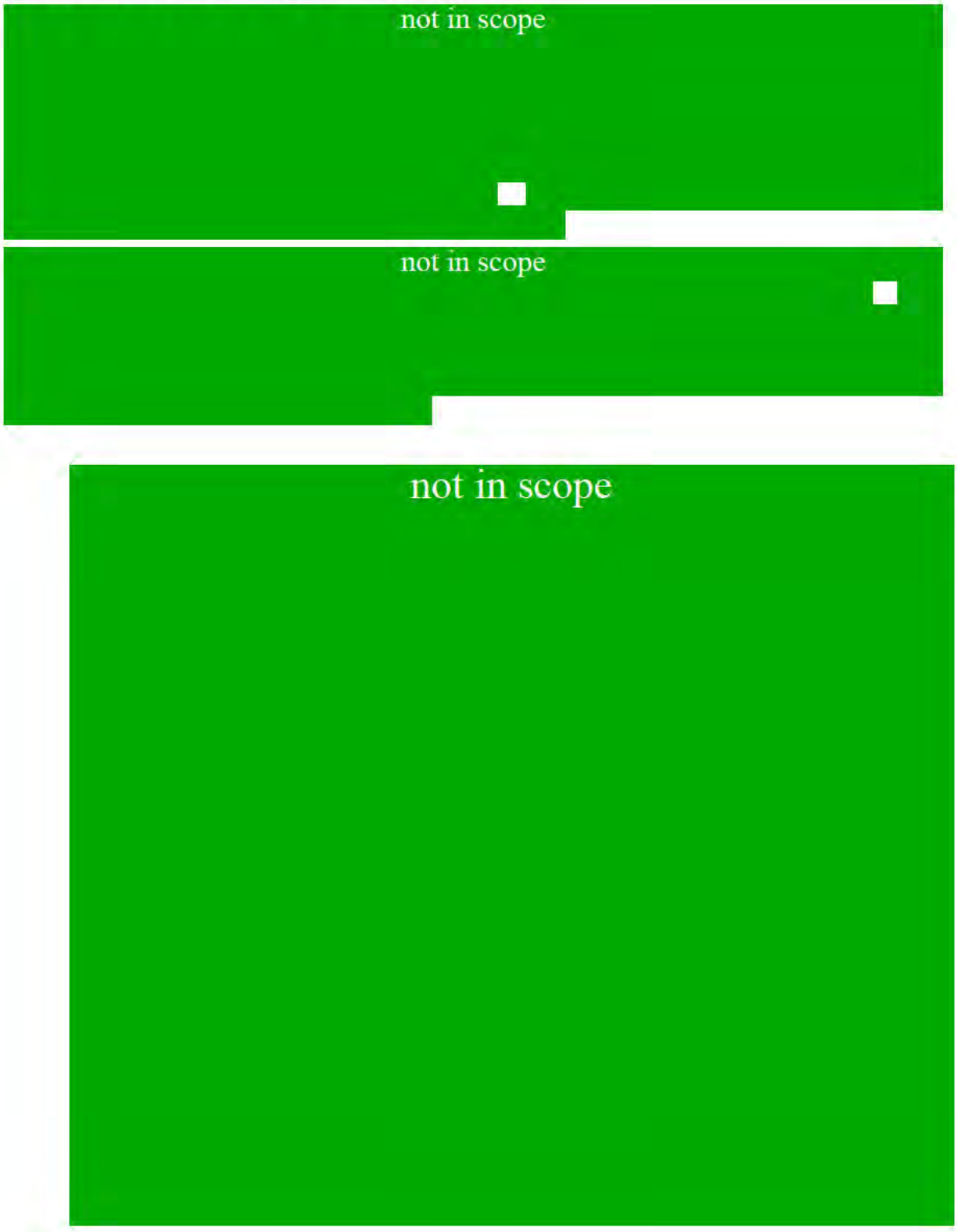


Figure 3-31. MRS Scout Curb-to-Curb

3.6.7.2 T-Junction Turn

3.6.7.2.1 MRS 4x4x4 (4x4) T-Junction Turn



3.6.7.2.2 MRS 5x5 T-Junction Turn

3.6.7.2.3 MRS Scout T-Junction Turn

For the T-Junction test course, the NATO AVTP-1 formulas dictated that the required road width for a HMMWV in a right-hand turn was 13.8 ft. Using the same formulas for the HMMWV/Scout together, the required road width was 22.7 ft for a right-hand turn. This equates to an overall degradation of 65% when compared to the performance of the HMMWV alone. Under physical test, the narrowest width that the HMMWV/Scout was able to negotiate proved to be 20 ft while turning right. This reduced the amount of performance degradation to 45%, when compared to the calculated value of the HMMWV alone.

In a left-hand turn the required road width for the HMMWV by itself was calculated at 13.7 ft, and the required road width for the HMMWV/Scout was calculated to 22.8 ft. This equates to a 66% degradation. Under physical test, the HMMWV/Scout was again able to negotiate 20.0 ft while turning left. This reduced the amount of performance degradation to 46%, when compared to the calculated value of the HMMWV alone. See Figure 3-34.

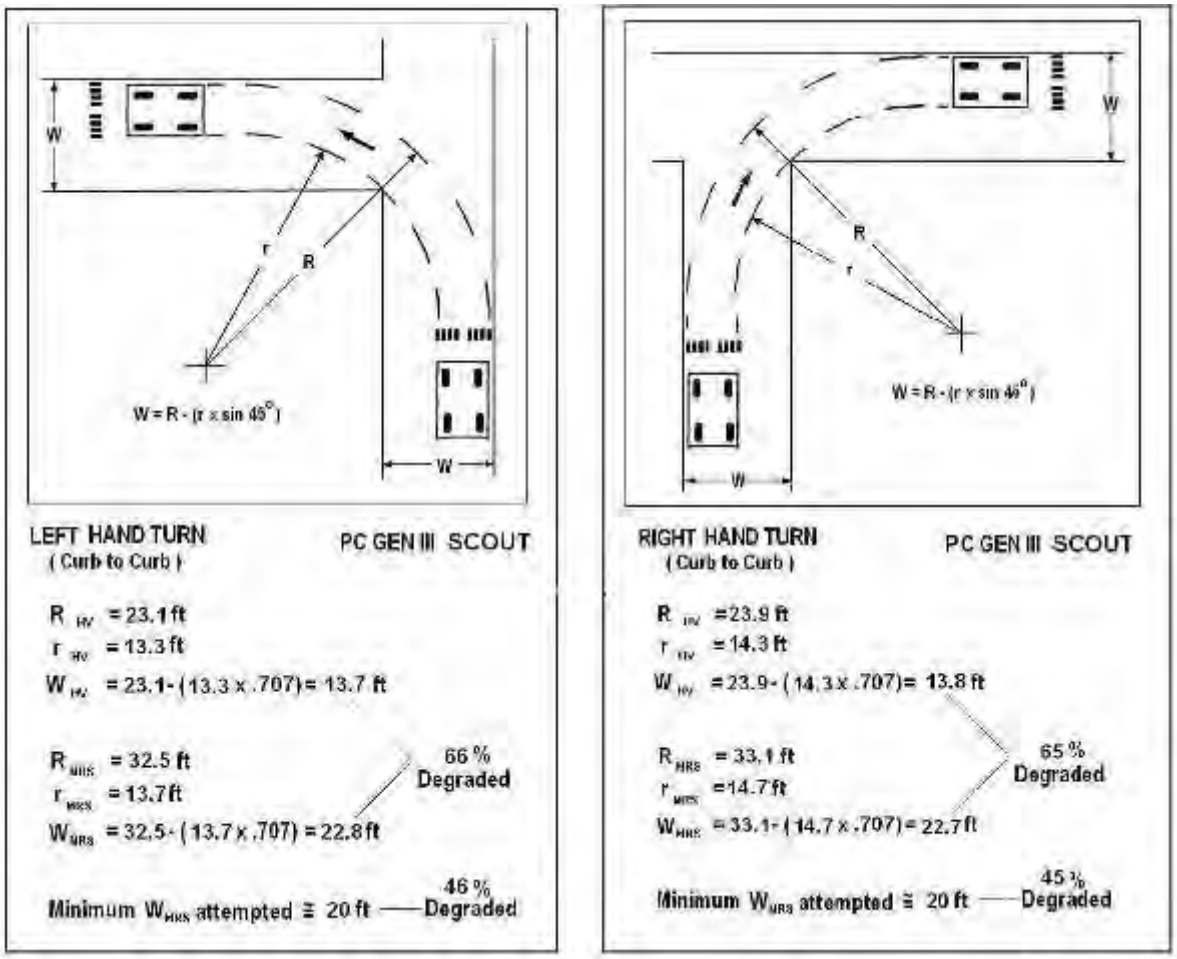


Figure 3-34. MRS Scout T-Junction

3.6.7.3 Braking Test

3.6.7.3.1 MRS 4x4x4 Braking Test

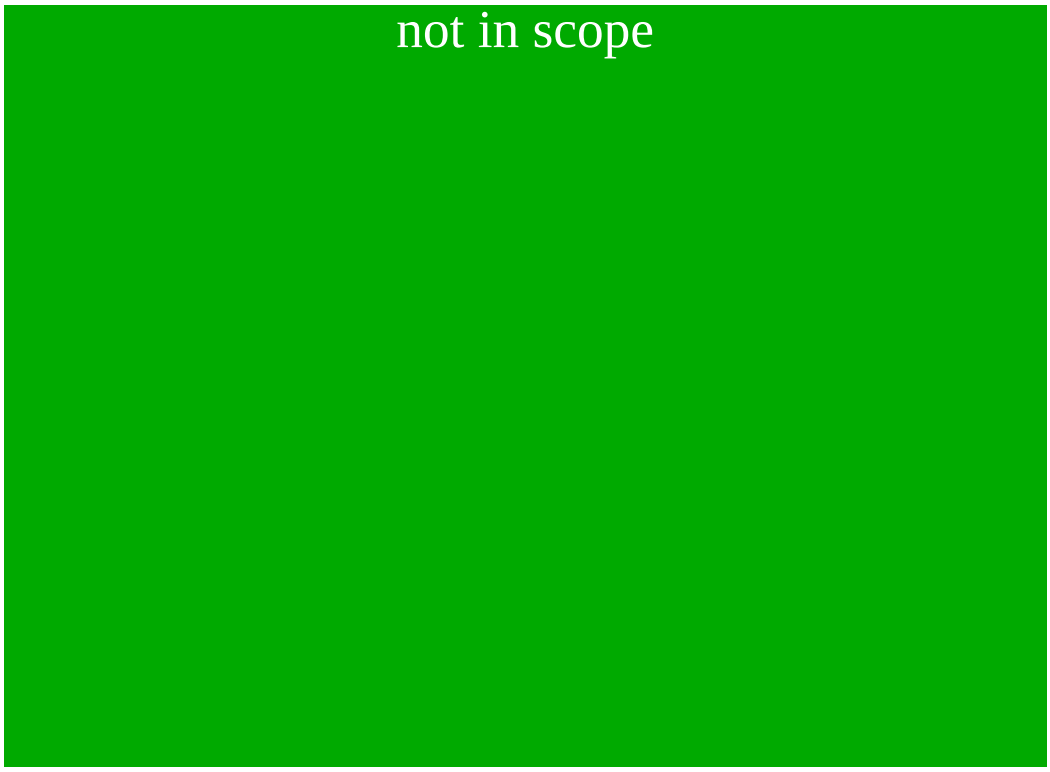
not in scope

not in scope

not in scope

3.6.7.3.2 MRS 4x4 Braking Test

not in scope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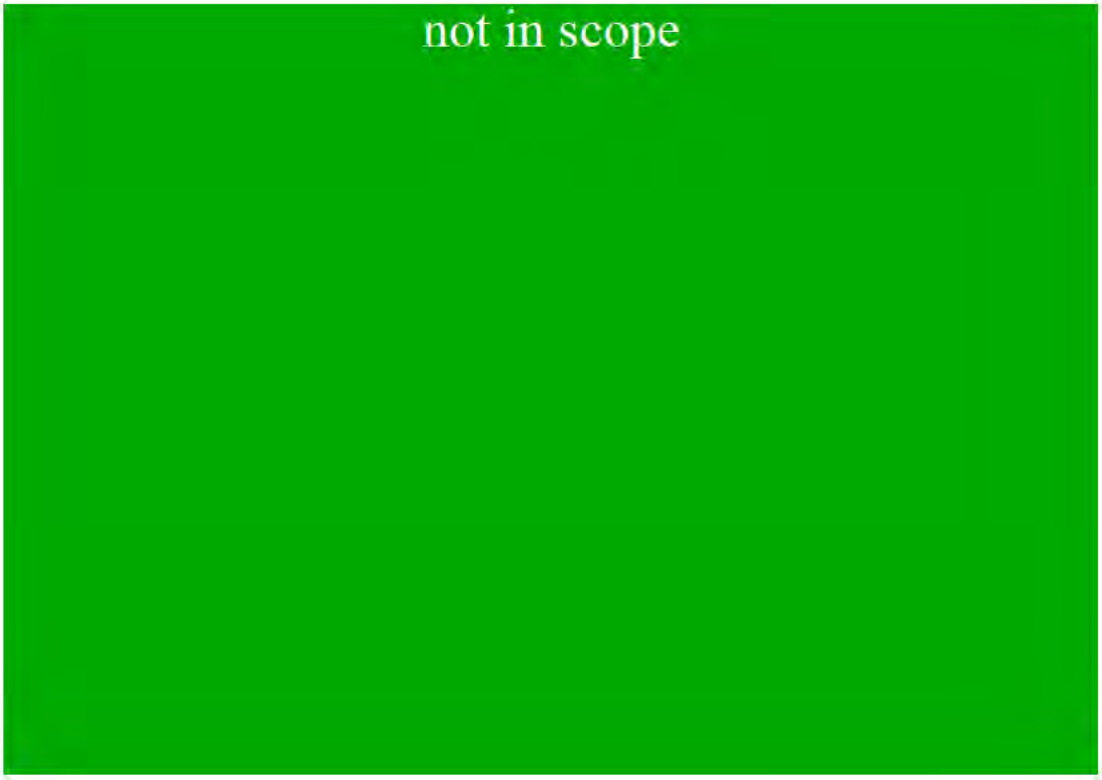
3.6.7.3.3 MRS 5x5 Braking Test

not in scope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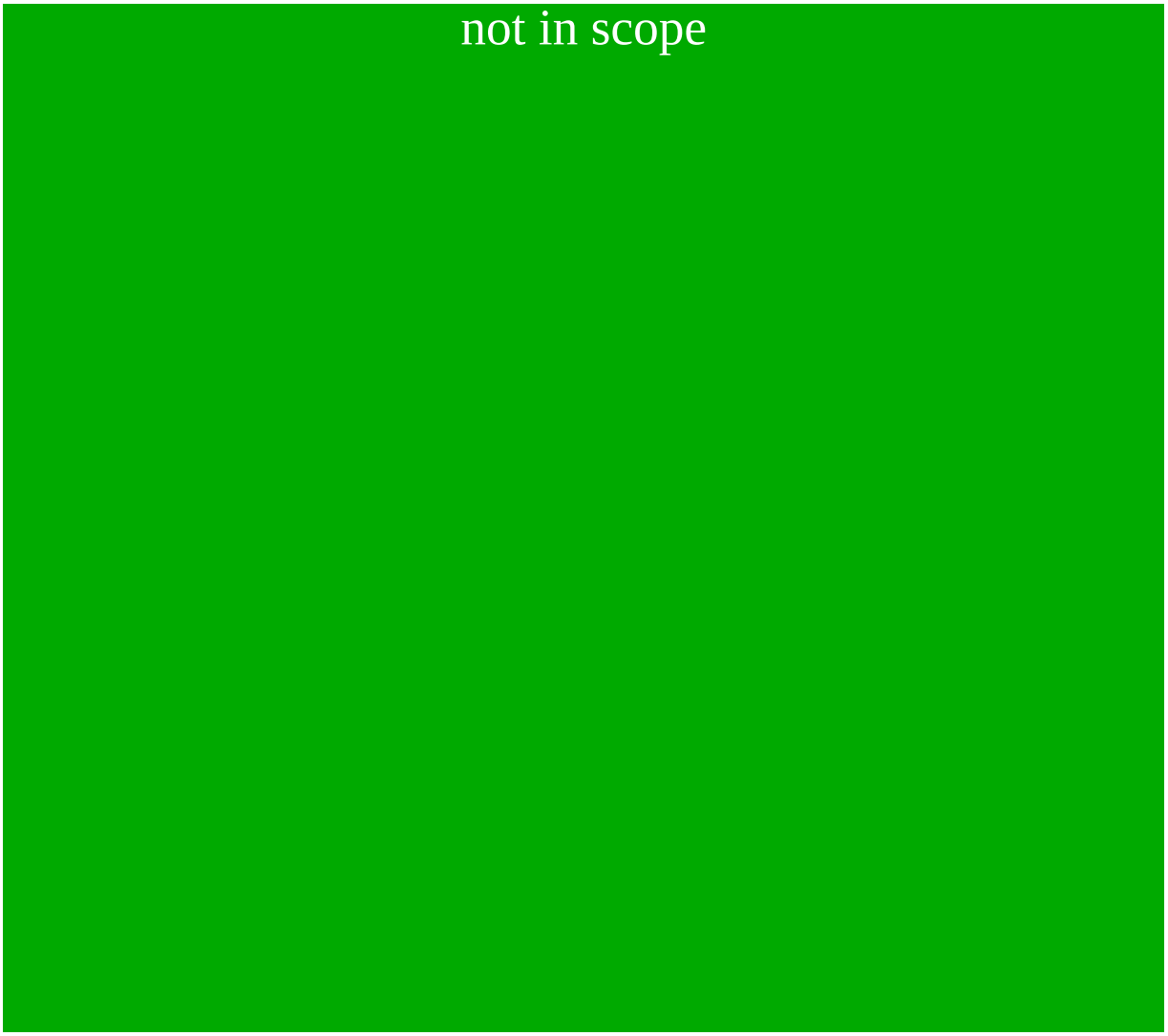


3.6.7.3.4 MRS Scout Braking Test

The average braking distance of the HMMWV with Scout attached increases (degrades) the braking distance of the HMMWV alone by less than 34% at most speeds. Table 3-12 and Figure 3-38 illustrates the difference in braking distance for the Scout with the HMMWV.

Table 3-12. Scout Brake Test Comparison

SPEED (mph)	M1116 HMMWV (SN 219046) Average Distance to Stop (ft)	HMMWV +MRS (SCOUT) Average Distance to Stop (ft)	Additional Distance Required to Stop (ft)	Percent Increase
5	4.0	4.0	0.0	0 %
10	7.3	8.7	1.4	19 %
15	14.0	18.7	4.7	34 %
20	24.3	31.7	7.4	30 %
25	39.7	43.0	3.3	8 %
30	54.0	62.0	8.0	15 %
35	66.3	85.0	18.7	28 %

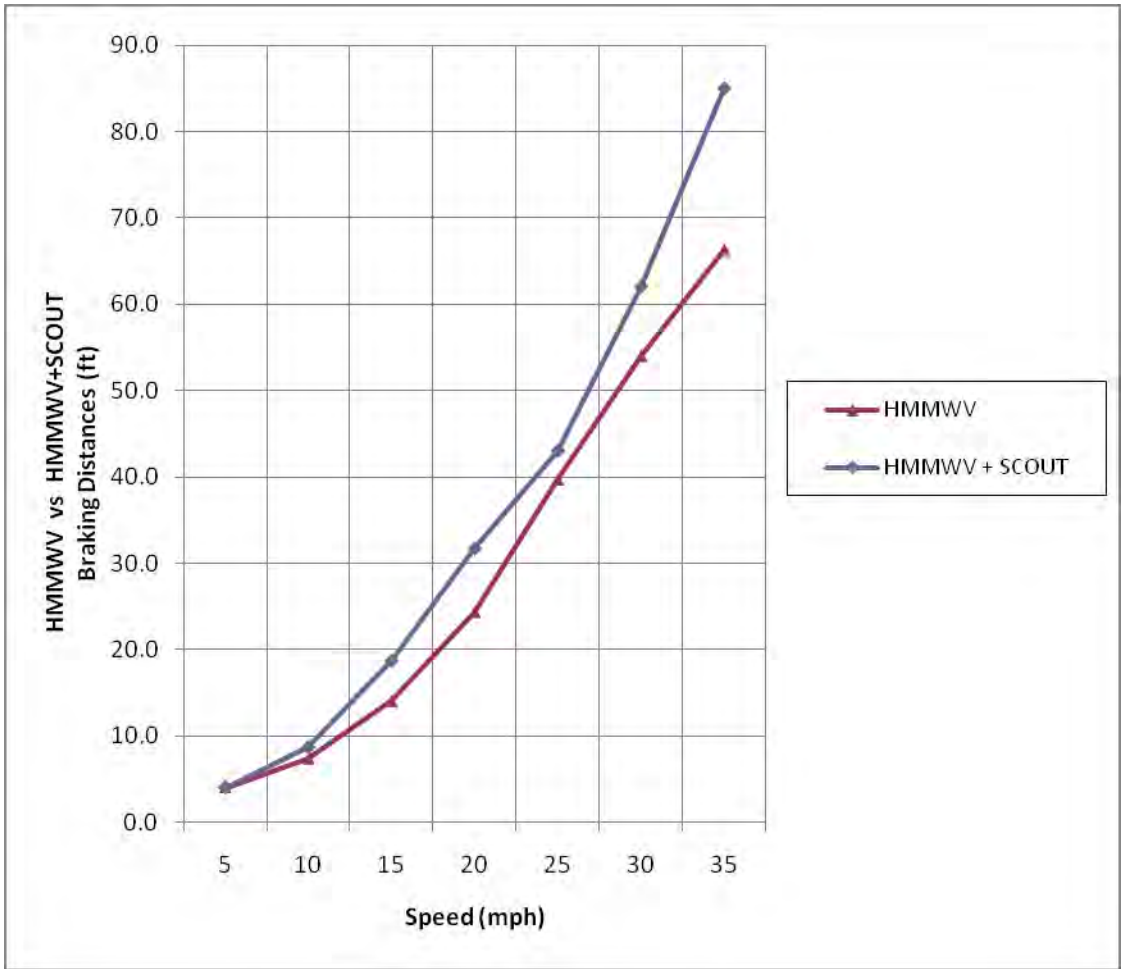


Figure 3-38. MRS Scout Brake Test Results

3.6.7.4 Double Lane Change

Double Lane Change Test gate widths and the distances between the gates are dictated by formulas in the NATO AVTP-1 documentation. These calculated dimensions are a function of the overall length and width of the vehicle system under test. not in scope HMMWV (alone) not in scope capable of easily maneuvering through not in scope Double Lane Change courses at speeds up to 35 mph. not in scope was able to maneuver the Double Lane Change Test course configured to not in scope overall dimensions. A not in scope

3.6.7.4.1 MRS 4x4x4 Double Lane Change

not in scope

not in scope

3.6.7.4.2 MRS 5x5 Double Lane Change

not in scope

.

not in scope

3.6.7.4.3 MRS Scout Double Lane Change

The HMMWV was able to successfully maneuver the Double Lane Change test course (up to 35 mph) with gate widths and the distances between the gates based on overall vehicle dimensions. The HMMWV with Scout was also able to successfully maneuver the Double Lane Change test course (up to 35 mph) with gate widths (and the distances between the gates) enlarged per the overall TV/MRS dimensions. The HMMWV/Scout course was no more than 41% larger (degraded) at any one feature than the respective course established for the HMMWV alone (see Table 3-15). Vehicle degradation was thus considered to be less than 41% for this performance parameter.

Table 3-15. MRS 4x4x4 Double Lane Change Results

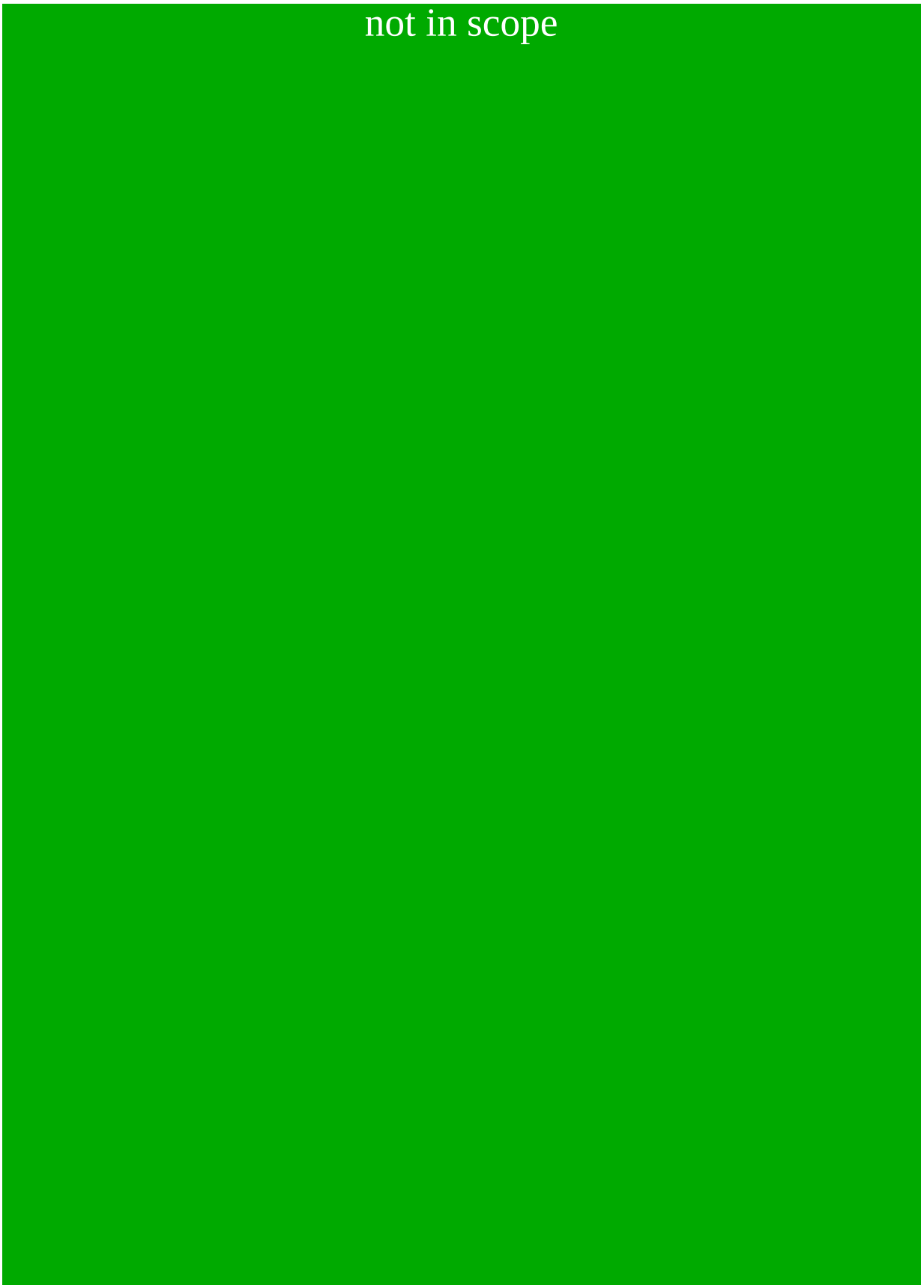
Section	Feature	HMMWV	HMMWV + SCOUT	Percent Increase of Feature
Section #1	Length (Ft)	49.2	49.2	0 %
	Width (Ft)	8.6	12.1	41 %
Section #2	Length (Ft)	94.4	105.5	12%
Section #3	Length (Ft)	82.0	82.0	0%
	Width (Ft)	9.3	13.1	41%
Section #4	Length (Ft)	94.4	105.5	12%
Section #5	Length (Ft)	49.2	49.2	0 %
	Width (Ft)	8.6	12.1	41 %

3.6.8 Attachment

None of the MRS configurations required the use of material handling equipment or special tools for attachment to a host TV (with MRIB presinstalled). Jack stands provided as an integral part of the MRS were used for support during alignment with the TV MRIB during the attachment process. No more than two personnel, excluding the TV driver, were used for attachment. Results for this test requirement for each MRS configuration are recorded in Appendix B, Table B-43.

3.6.9 Detachment

None of the MRS configurations required the use of material handling equipment or special tools for detachment from the host TV. Jack stands provided as an integral part of the MRS were used for support during detachment. No more than two personnel, excluding the TV driver, were used for detachment. Results for this test requirement for each MRS configuration are recorded in Appendix B, Table B-44.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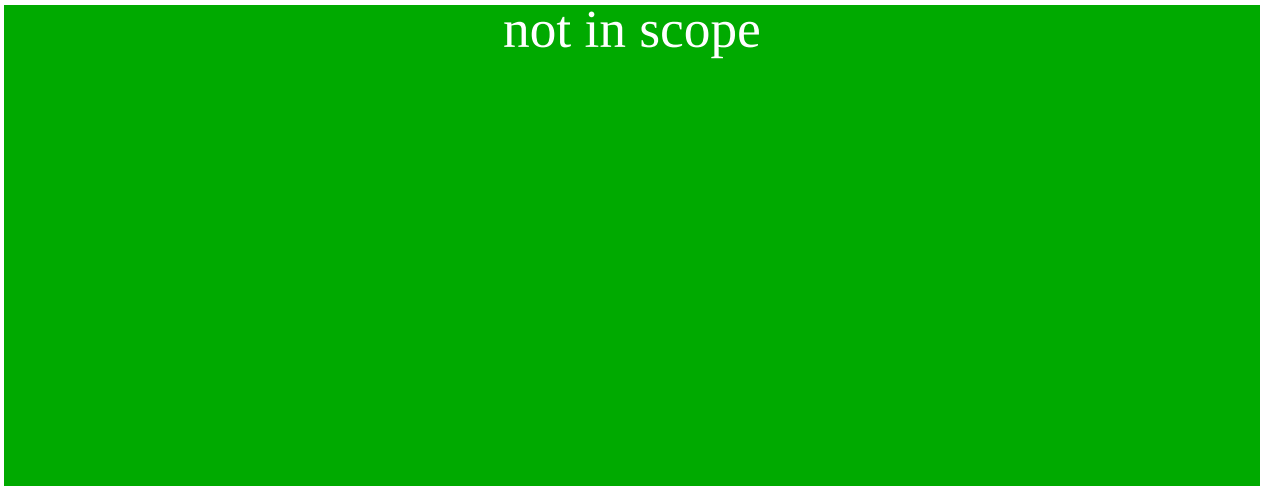
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APPENDIX A
CONFORMANCE INSPECTION RESULTS

A.1 PC GEN III MRS Conformance Inspection Results

Table A-1. Tactical Vehicle Data

Attribute/Parameter	Attribute/Parameter			
	4x4x4	4x4	5x5	Scout
Vehicle make/model	Mk 27 MTVR - Armored			M1116 HMMWV
Vehicle serial number	072685			219046
Vehicle contract number	M67854-04-D-5016			DAAE07-00-C-S019
Vehicle contract date	07/2005			08/2005
Gross vehicle weight (GVW) (lb)	62,200			12,100
Overall weight (lb)	35,920			10,860
Overall Length (in.)	387			188 (bumper to bumper)
Overall Width (in.)	98			85 (across wind shield)
Host MRIB make / model number	MTVR FX/40190			HMMWV/38840
MRIB weight (lb)	212 (per Field Install Manual)			300 (per Field Install Manual)
MRIB bracket height from deck (in.)	21.5 (to lowest point) 24.5 (at CL of attach point)	20.5 (lowest point) 24.0 (at CL of attach point)	21.0 (to lowest point) 23.0 (at CL of attach point)	19.0 (to lowest point) 22.0 (at CL of attach point)

Table A-2. Front Axle Loading (TV + MRS)

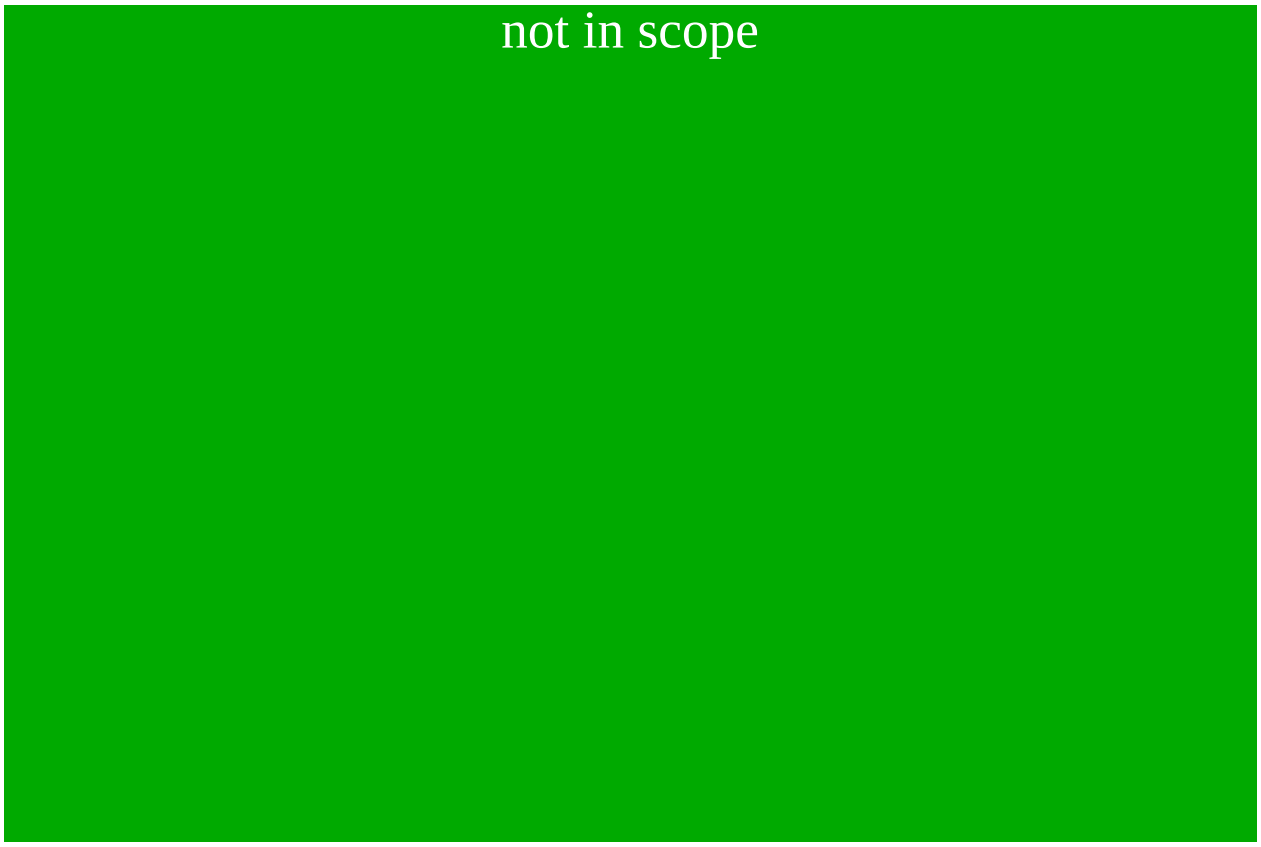
Front Axle Loading Attribute/Parameter	Attribute/Parameter			
	MTVR+ 4x4x4	MTVR + 4x4	MTVR+ 5x5	HMMWV+ Scout
Vehicle only (lb)	not in scope			2,500
Vehicle w/ FX MRIB (lb)				2,660
Vehicle w/ MRS - wheels in forward (lb)				2,810
Vehicle w/MRS - wheels in reverse (lb)				3,280

Table A-3. Angle of Approach

Angle of Approach Attribute/Parameter	Attribute/Parameter			
	4x4x4	4x4	5x5	Scout
- Vehicle only (°)	not in scope			54
- Vehicle w/MRIB (°)				35.5
- MRS only (°)				62.8
- Vehicle w/MRS in forward drive position (°)				38

Table A-4. Standoff Distance Measurements

Attribute/Parameter	Attribute/Parameter	
	not in scope	Scout
SOD from center of attachment pin on MRIB, to center of aft most wheel of Forward Wheel-bank (in.)		95 (wheels 1,4, 5, & 8)
Distance from center of attachment pin on MRIB, to center of aft most wheel of Aft Wheel-bank (in.)	not in scope	100 (wheels 2,3, 6, & 7)
Distance from center of attachment pin on MRIB, to center of pivot axis of Forward Wheel-bank trunnion (in.)		113
Distance from center of attach pin on MRIB, to pivot axis of A-Frame Clevis Pivot (in.)		Not Applicable – Does not have pivot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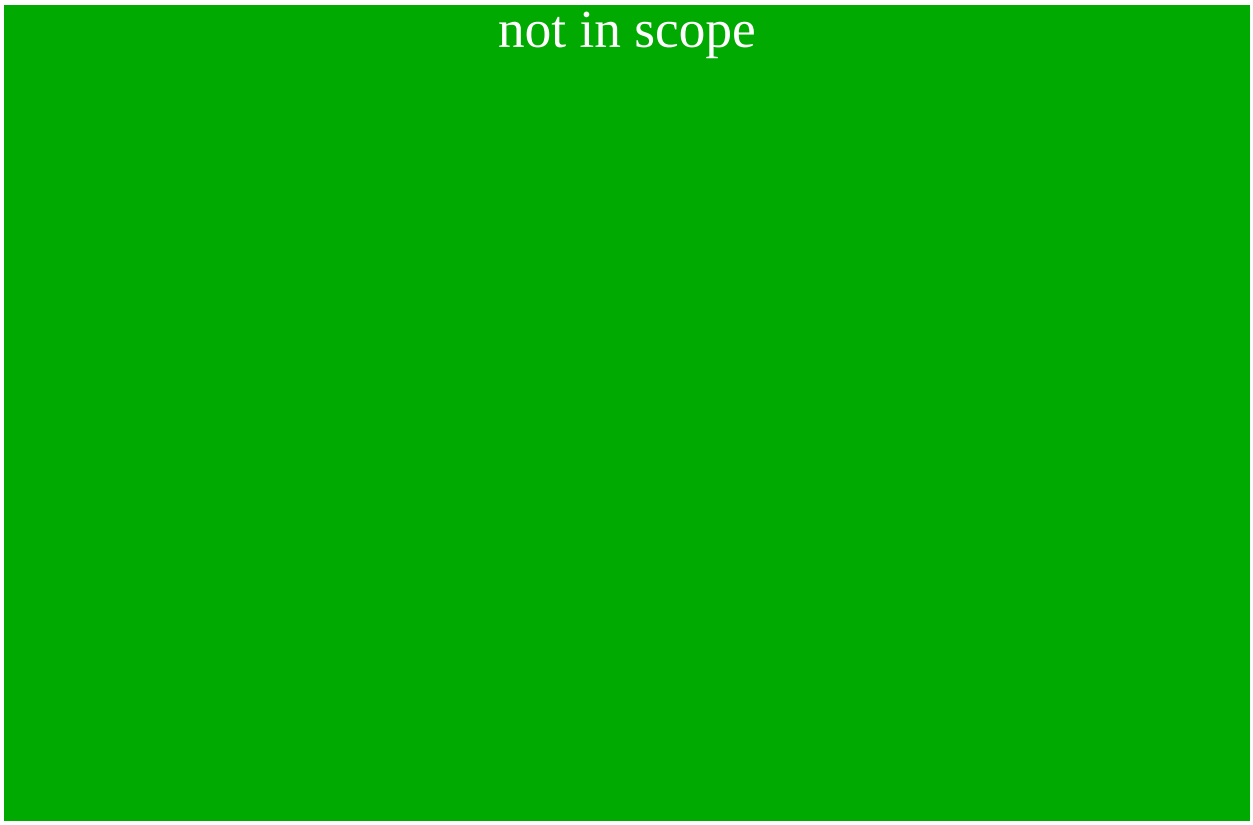
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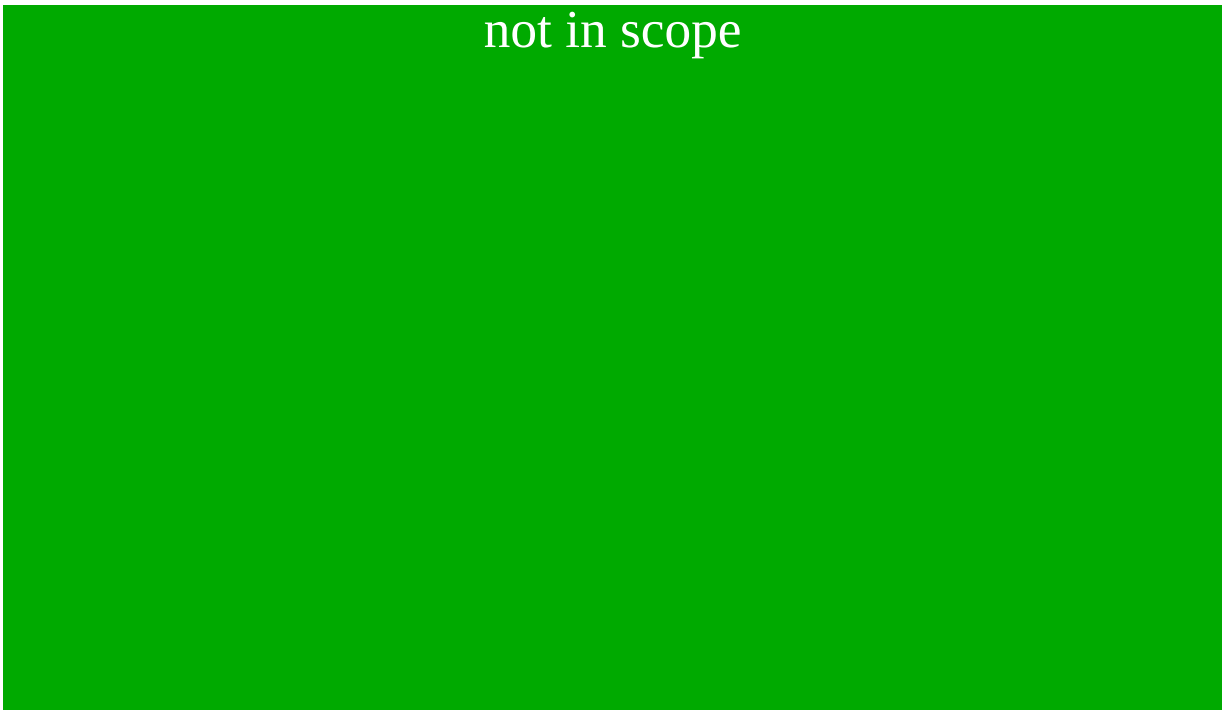

Table A-8. Scout Tongue Loading

Attribute/Parameter	Attribute/Parameter		
Tongue Heights (in.) (MRS mounting pin heights from ground, not attached to TV; heights achieved using tongue load test fixture and forklift).	22.5	24.5	30.5
No. of mounting pad eyes	Two point attachment		
Mounting pad eyes, height from ground (in.) (As measured height with MRS attached to TV).	22.0 (to CL of pin)		
Total tongue weight, wheels in forward (lb)	270	270	245
Total tongue weight, wheels in reverse (lb)	965	965	965

Table A-9. Torsion Spring Description

Attribute/Parameter	Attribute/Parameter	
	not in scope	Scout
Size	#14 High Torque Welded Arm MFG Axis Products Inc.	
Length (in.)	9.5	
Type (index-able or fixed)	Fixed (welded)	
Angles (°)	45	

not in scope

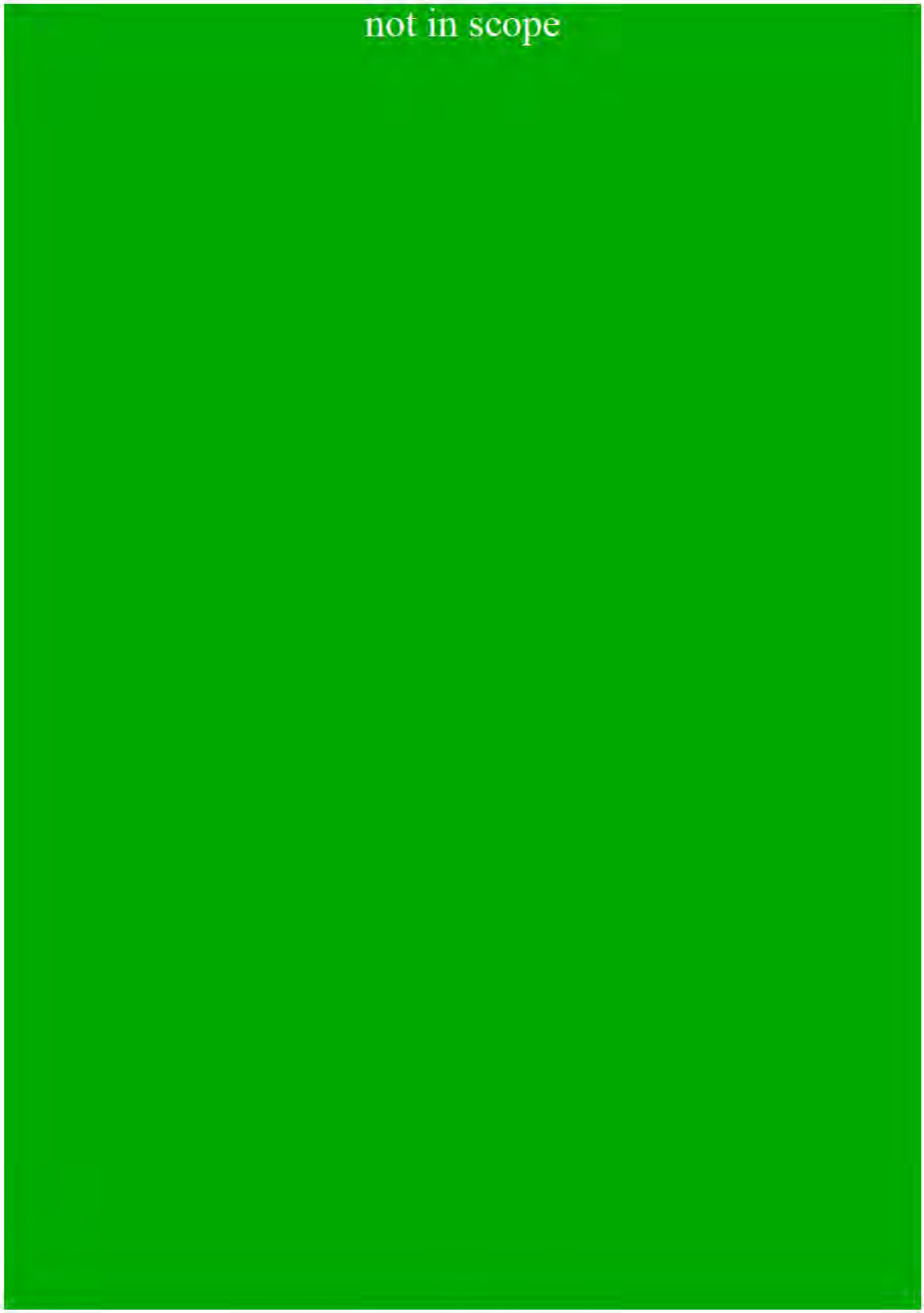
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Table A-13. Scout Individual Wheel Loading Profile

Wheel Bank	Wheel Number	Wheel Load (lb) (Less base weight "A")	Loaded Angle (°)
Forward Driver Side (L to R)	1	34 + A	39.0
	2	25 + A	39.3
	3	10 + A	37.4
	4	206 + A	37.5
Forward A-Driver Side (L to R)	5	140 + A	36.4
	6	209 + A	38.1
	7	18 + A	37.9
	8	17 + A	38.6

Table A-14. Slewing Characteristics, Stationary

Attribute/Parameter	Attribute/Parameter
	not in scope
Max slew angle (°) (+/- from centerline)	N/A Does not slew
Slew lag time (s) (Start to actual motion)	N/A Does not slew
Time to slew (s) (Center-to-full left)	N/A Does not slew
Time to slew (s) (Center-to-full right)	N/A Does not slew
Time to slew (s) (Full right-to-full left)	N/A Does not slew
Time to slew (s) (Full left-to-full right)	N/A Does not slew

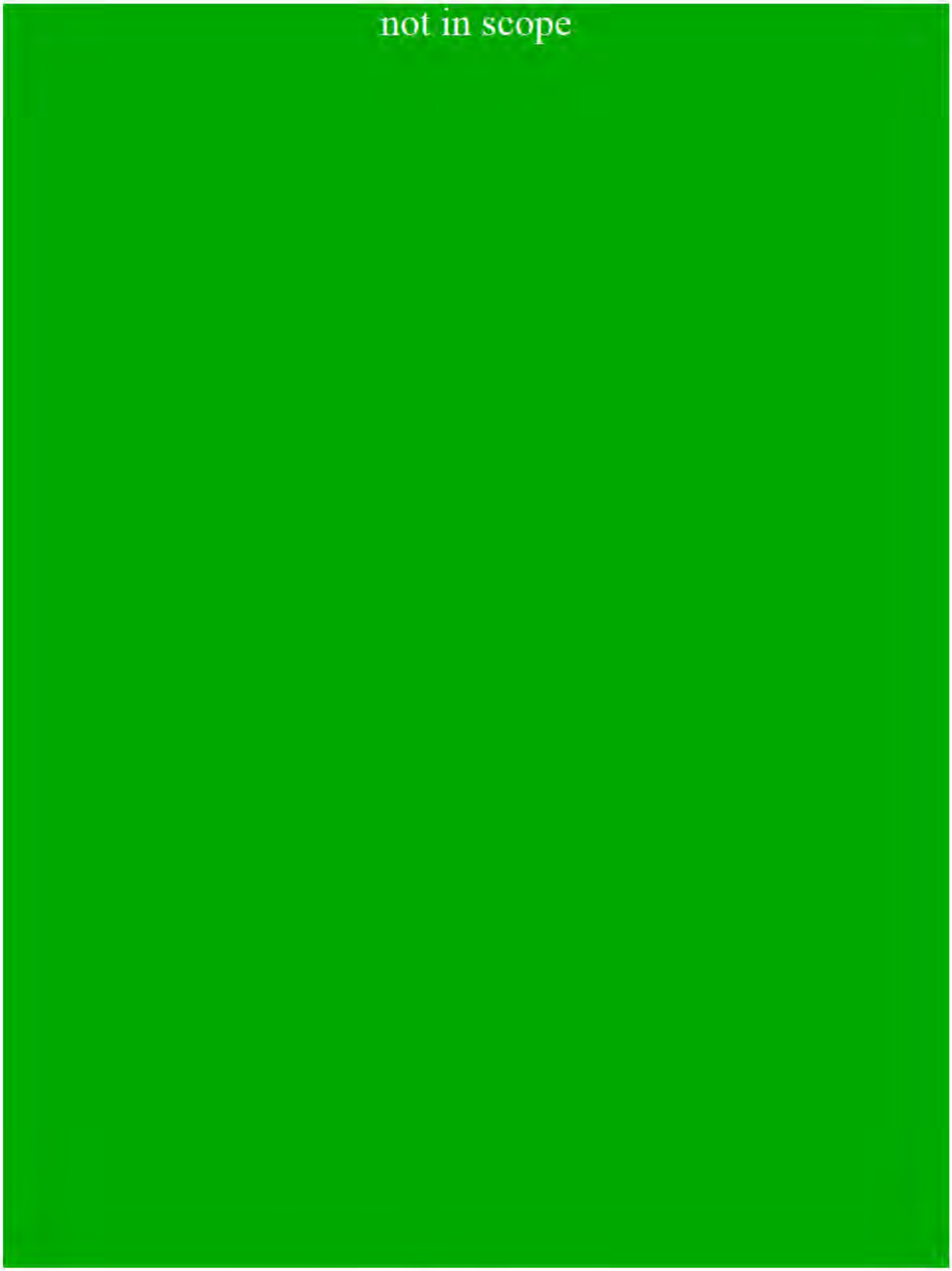
Table A-15. MRS Overall Dimensions

Attribute/Parameter	Attribute/Parameter
	Scout
Length (in.)	124 (Attachment Pin to Front Tow Bracket)
Width (in.)	123 (Across Wheel Bank Tables)
Height (in.)	49.5 (To Top of Lights) 44.0 (To Top of Electrical Box)

not in scope


not in scope

not in scope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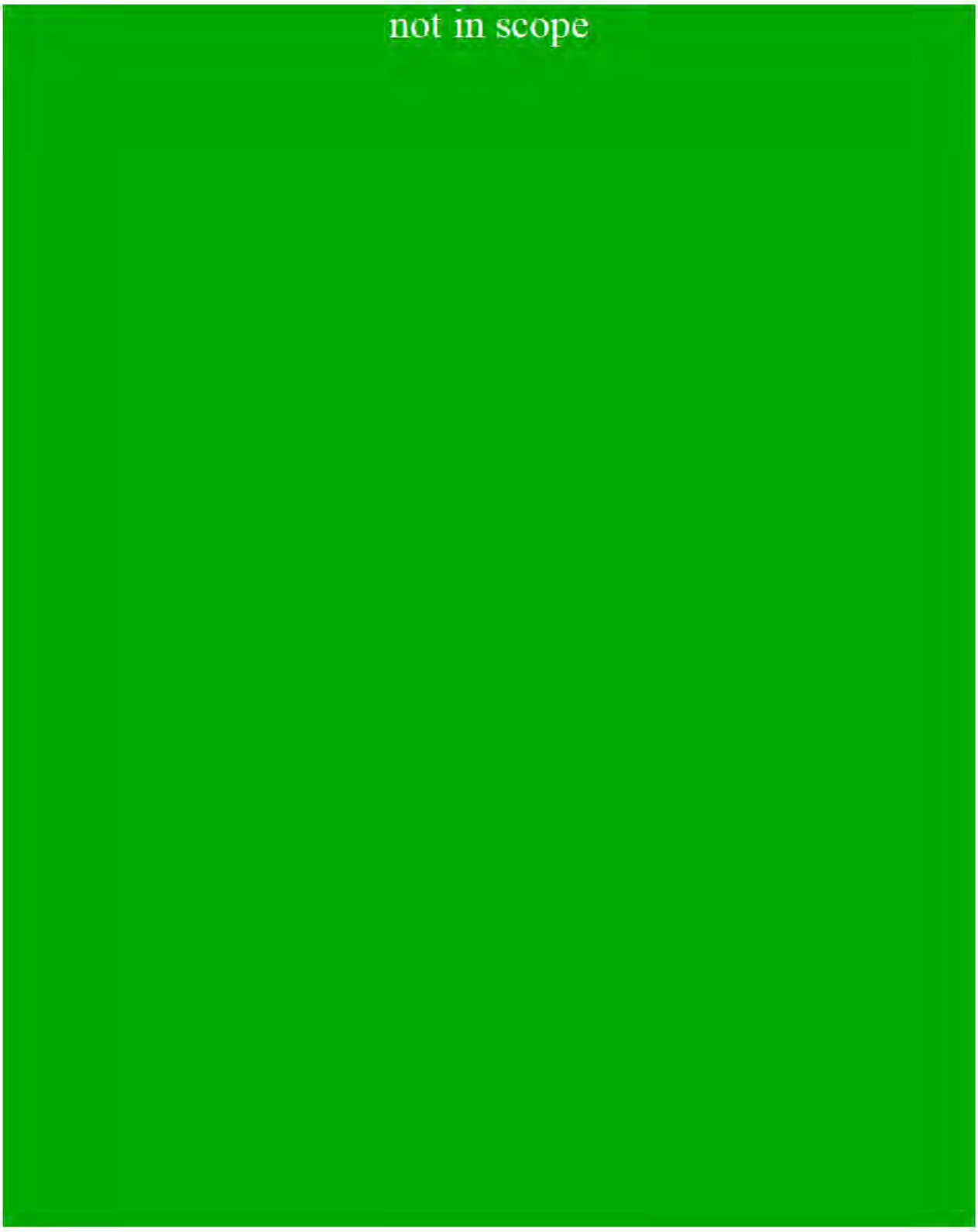
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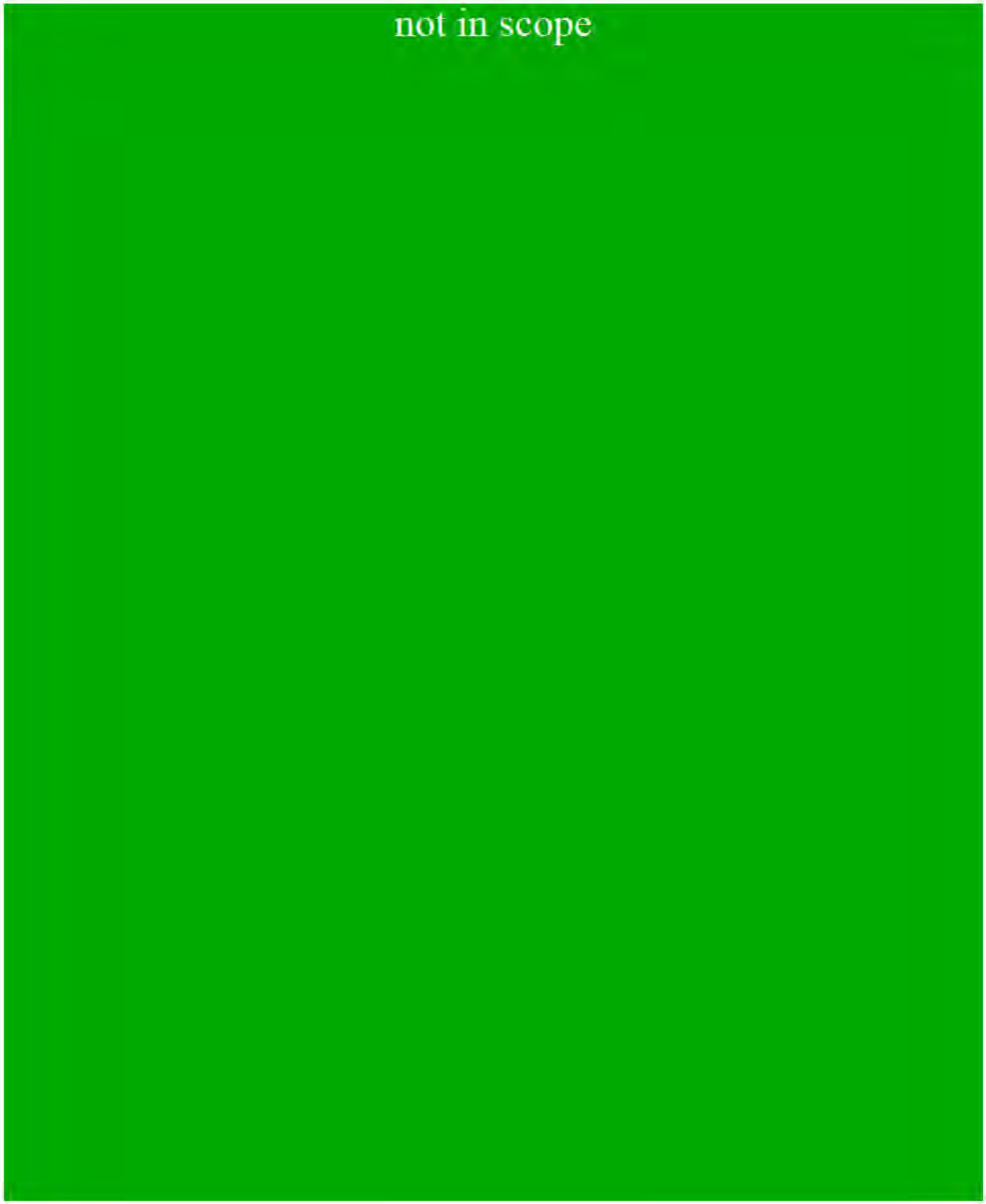
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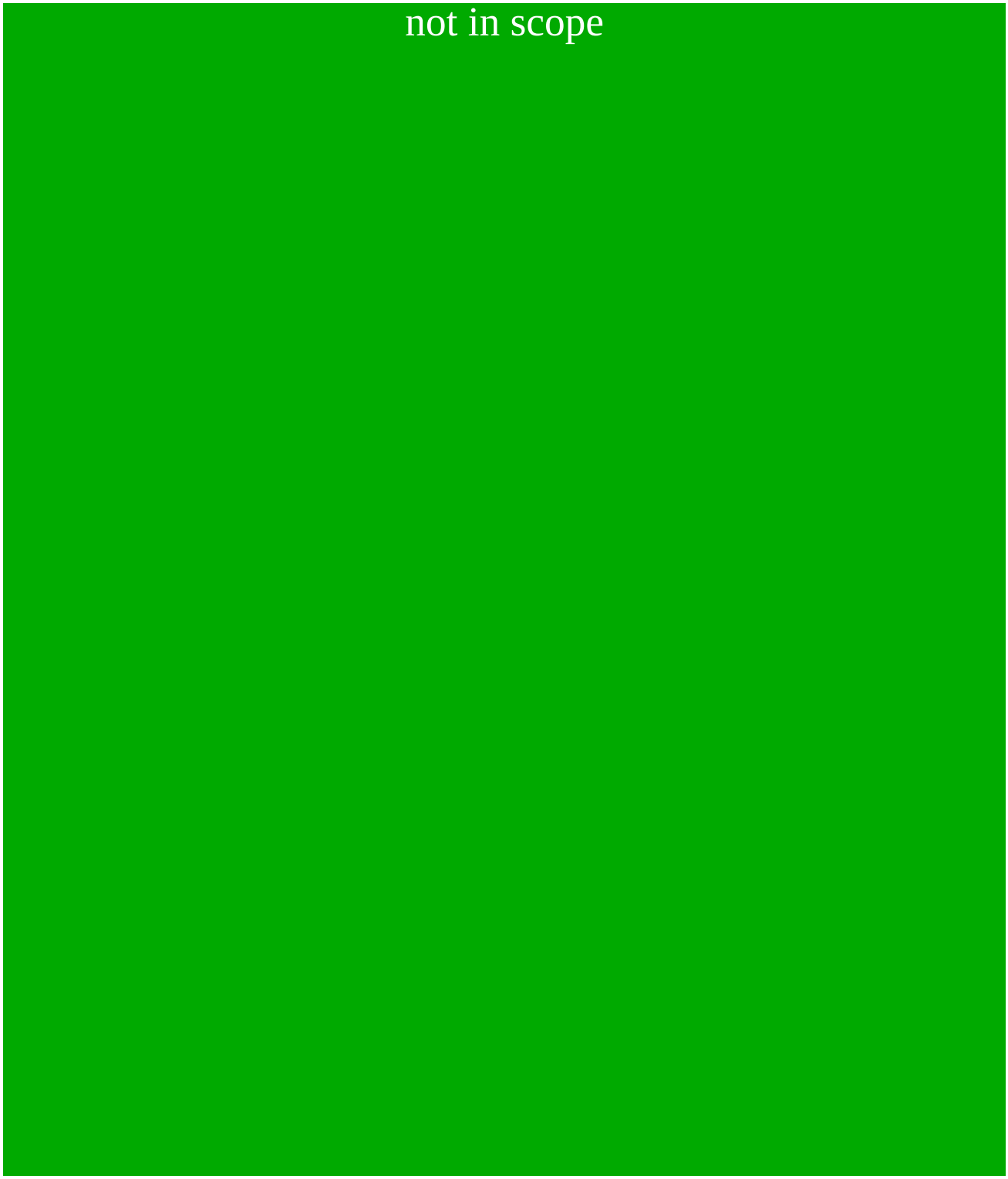
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APPENDIX B
PC GEN III MRS GVT RESULTS

B.1 Interface and Interoperability

This test is discussed in Paragraph 3.2.1 of this report.

Table B-1. Mechanical Interface

Requirement: The MRS shall be capable of being installed on the TV utilizing a specific MRIB presented in the MRIB Technical Data Package without the use of special tools or material handling equipment.		
Verification: The Government will verify by testing that the MRS is capable of being installed onto the TV. The Government will utilize the existing vehicle-specific MRIB.		
Notes: Perform Mechanical Interface in coordination with the two Attachment requirements (5.2.16 and 5.2.51) and the Common Tools and Parts requirement (5.2.28).		
Methodology	not in scope	**Scout Result**
1. Measure tongue height with jack stand at its lowest height.		0.0 in.
2. Measure tongue height with jack stand at its greatest height.		30.0 in.
3. Install MRS onto TV using appropriate MRIB. Record time and number of personnel required for complete installation.		3 min 20 s Two people No tools required
4. Has the Mechanical Interface requirement been completely verified?		YES
NOTES: not in scope Scout HMMWV Bracket – 272 lbs ~10 min to install on or remove from HMMWV Two 2 ¼-in. wrenches required.		

This test is discussed in Paragraph 3.2.2 of this report.

Table B-2. Non-Interference

Requirement: The MRS shall not interfere with the use or function of the TV it is attached to, to include but not limited to, blocking access to the hood, usage of doors and windows.				
Verification: The Government will verify by testing that the MRS does not interfere with the use or function of the TV it is attached.				
Notes: Tactical vehicles available for test were the MTVR and HMMWV. Additional tests are required on the MRAP family of vehicles.				
Methodology	not in scope			**Scout Result**
1. Is the TV hood accessible with the MRS attached?				YES
2. Are the TV doors usable towards their intended function with the MRS attached?				YES
3. Are the TV windows usable towards their intended function with the MRS attached?				YES
4. Has the Non-interference requirement been completely verified?				YES

This test is discussed in Paragraph 3.2.3 of this report.

Table B-3. Electrical Interface

Requirement: The MRS shall function properly with the TV through the use of the 24-Vdc standard North Atlantic Treaty Organization (NATO) slave receptacle, ensuring proper grounding, without adverse negative effect to the TV or operators.		
Verification: The Government will verify by testing that the MRS functions properly with the TV 24-Vdc, standard NATO slave receptacle.		
Notes: ▪ This requirement will be verified by supplying power to the MRS from the TV through the 24-Vdc standard NATO slave receptacle. ▪ This requirement will be satisfied by deduction—by satisfying other requirements listed in the methodology below. ▪ Derived requirement—power and control cables shall facilitate system operation.		
Methodology	not in scope	**Scout Result**
1. Power Consumption (5.2.4) requirement must be satisfied.		YES
2. Steering (5.2.18) requirement must be satisfied.		Not Applicable - The Scout configuration does not steer.
3. Driving Lights (5.2.20) requirement must be satisfied.		YES
4. Waterproof (5.2.24) requirement must be satisfied.		YES
4. Fording (5.2.25) requirement must be satisfied.		YES
5. Temperatures (5.2.7) requirement must be satisfied.	Not Applicable—Test Not Conducted	
6. Does the NATO slave connector properly fit to the host vehicle receptacle?	not in scope	YES
7. Has the Electrical Interface requirement been completely verified?		YES

Results for this section are discussed in Paragraph 3.2.4 of this report.

Table B-4. Power Consumption

Requirement: ▪ The MRS shall have a maximum continuous current draw for lights, controls, and other continuously operating equipment of 40 A. ▪ The MRS shall have a maximum steady state intermittent current of 240 A (200 A intermittent plus 40 A continuous) during operation of any steering or down-pressure system, for no more than 15 s.			
Verification: ▪ The Government will verify by testing that the MRS has a continuous current draw for lights, controls and other continuously operating equipment of less than 40 A. ▪ The Government will verify by testing that the MRS has a maximum steady state intermittent current of less than 240 A (200 A intermittent plus 40 A continuous) during operation of any steering or down-pressure system, for no more than 15 s.			
Notes: ▪ Electricity supplied to MRS must be by the host vehicle through the use of the 24-Vdc standard NATO slave receptacle. ▪ Down-pressure will be tested if the MRS is equipped with this feature. ▪ Slack management will be tested during this test—it will be documented by taking photographs.			
Special Test Support Resources: ▪ Ammeter capable of measuring 300 amps and a voltmeter capable of measuring 50V. ▪ Wires and tools for tapping into the main power source cable.			
Methodology	not in scope	**Scout Result**	**All Systems Pass/Fail**
1. Maximum TV alternator output		400 A; 25 V	not in scope
2. With the TV engine off, plug MRS power cord into the NATO receptacle on the TV. Measure MRS power consumption (amperage and voltage).		0 A; 25 V	
3. Start the TV engine. Measure MRS power consumption (amperage and voltage).		0 A; 25 V	
4. Power on IR lights. Measure MRS power consumption (amperage and voltage). Power off IR lights.		7.1 A; 25 V	

Table B-4. Power Consumption (continued)

Methodology	not in scope	Scout Result	All Systems Pass/Fail
5. Power on white lights. Measure MRS power consumption (amperage and voltage). Power off visible lights.		19.2 A; 25 V	not in scope
6. From the MRS in straight position, operate steering to the right until MRS turns fully to the right (lights are off). Record time to complete full turn, amperage, and voltage.		N/A	
7. Measure the positional angle of MRS from straight to full right.		N/A	
8. From the MRS in full right position, operate steering to the left until MRS turns fully to the left (lights are off). Record time to complete full turn, amperage, and voltage.		N/A	
9. Measure the positional angle of MRS from straight to full left (lights are off).		N/A	
10. From the MRS in full left position, operate steering to the right until MRS turns to straight position (lights are off). Record time to complete full turn, amperage, and voltage.		N/A	
11. Turn white lights on. From the MRS in straight position, operate steering to the right until MRS turns fully to the right. Record time to complete full turn, amperage, and voltage.		N/A	
12. Turn white lights on. From the MRS in full right position, operate steering to the left until MRS turns fully to the left. Record time to complete full turn, amperage, and voltage.		N/A	

Table B-4. Power Consumption (Continued)

Methodology	not in scope	Scout Result	All Systems Pass/Fail
13. Turn white lights on. From the MRS in full left position, operate steering to the right until MRS turns to straight position. Record time to complete full turn, amperage, and voltage.		N/A	not in scope
14. Has the Power Consumption requirement been completely verified?		YES	

B.2 Physical

This test is discussed in Paragraph 3.3.1 of this report.

Table B- 5. Gross Weight

Requirement: When attached to the front of the TV, the MRS gross weight shall not degrade the TV's operational mobility by more than 25% (O), 50% (T).		
Verification: The Government will verify by analysis, demonstration, or testing that the MRS gross weight does not degrade TV's operational mobility by more than 25% (O), 50% (T).		
Notes: This requirement will be tested in conjunction with the Tactical Vehicle Degradation requirement (5.2.50).		
Methodology	not in scope	**Scout Result**
1. Weight of MRS.		4,420 lb
2. Weight of MRIB.		HMMWV Front Interface Bracket (Dwg38840) 272 lb
3. Tactical Vehicle Degradation (5.2.50) requirement must be satisfied.		YES
4. Has the Gross Weight requirement been completely verified?		YES

Table B- 6. Length, Width, Height

Requirement:

- The MRS length, width, and height shall not cause degradation to the use and operation of the TV.
- When attached to the TV, the MRS shall not adversely obscure the vision of the TV crew.
- When attached to the front of the TV, the roller's length, width, and height shall not degrade the TV's operational mobility by more than 25% (O), 50% (T);.
- The MRS length, width, and height shall not adversely obscure the vision of the TV crew.

Verification:

- The Government will verify by analysis, demonstration, or testing that the MRS length, width, and height does not degrade the TV's operational mobility by more than 25% (O), 50% (T).
- The Government will verify by analysis, demonstration, or testing that the MRS length, width, and height will not adversely obscure the vision of the TV crew.

Notes:

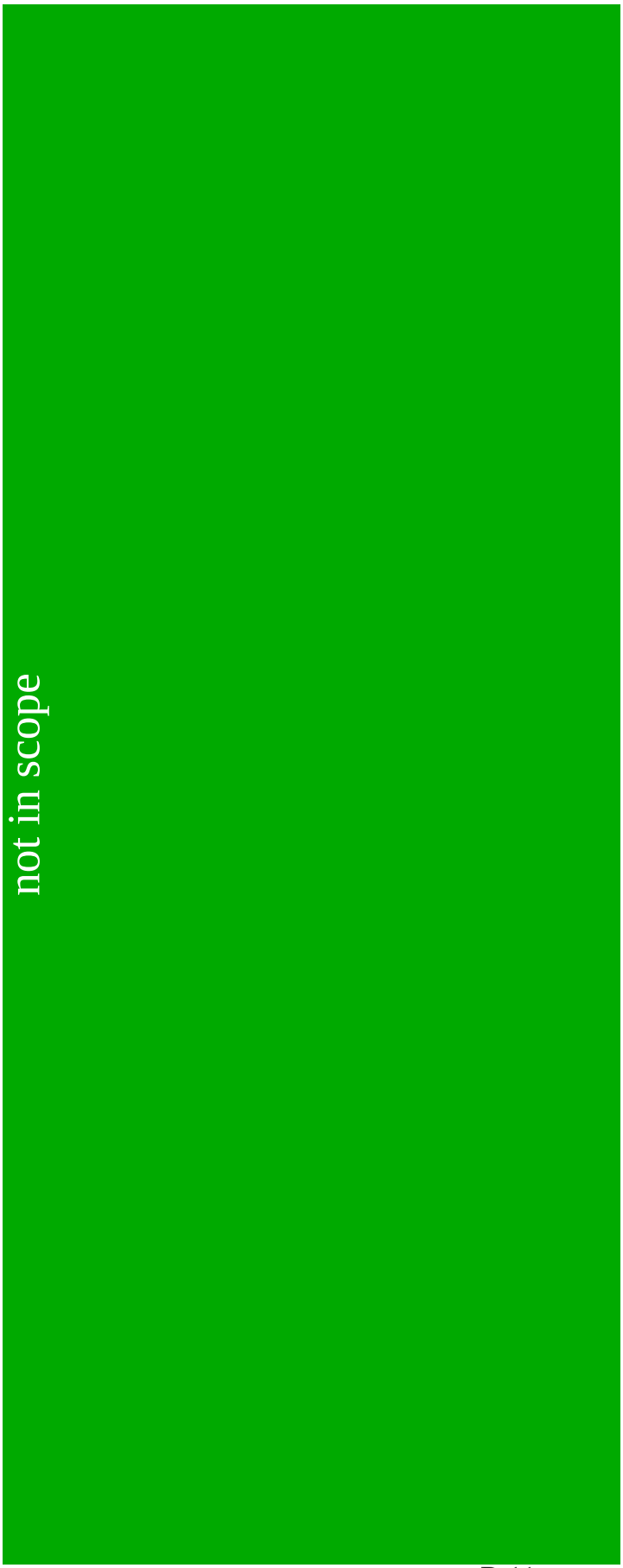
- This requirement will be tested in conjunction with the Mechanical Interface (5.2.1), Non-interference (5.2.2), and Tactical Vehicle Degradation (5.2.50) requirement.
- Results of this test will depend on qualitative observations by test personnel.

Methodology	Scout Result
1. While MRS is attached to the TV, test personnel will operate the TV/MRS system and observe whether the MRS obscures vision from the perspective of the TV crew.	MRS does not significantly obscure view of TV crew. The MRS does extend visual obstruction directly forward of the vehicle by ~100%.
2. Perform blind spot test by means of Polar Plots during day time. Ensure that the perimeter markers are visible.	ime Field-of-View test conducted on MRS
3. Perform blind spot test by means of polar plots during night time. Ensure that the perimeter markers are visible.	nd polar plot generated.
4. Tactical Vehicle Degradation (5.2.50) requirement must be satisfied.	YES
5. Does MRS obscure the vision of the TV crew?	Not significantly even though it extends blind spot directly forward of the HMMWV by ~100%.

not in scope

Table B-6. Length, Width, Height (continued)

not in scope	Scout Length—124 in. from mounting bracket to front tow bracket. Width—123 in. at wheel bank tables Height—49.5 in. to top of lights; 44 in. to top of hydraulic box.


not in scope

B.4 Design

This test is discussed in Paragraph 3.5.1 of this report.

Table B- 8. Attachment

Requirement: The MRS shall be mounted entirely to the front of the TV, using a vehicle-specific MRIB.		
Verification: The Government will verify by testing that the MRS mounts entirely to the front of the TV utilizing a vehicle-specific interface bracket.		
Notes: This requirement will be tested in conjunction with the Mechanical Interface (5.2.1) requirement.		
Methodology	not in scope	**Scout Result**
1. Install MRS onto TV using appropriate MRIB. Is it mounted entirely to the front of TV?		YES—Two personnel attached MRS to TV (HMMWV with MRIB) in 3 min 20 s. No tools required
2. Has the Attachment requirement been completely verified?		YES

This test is discussed in Paragraph 3.5.2 of this report.

Table B- 9. Detachment

Requirement: The MRS shall be equipped with a means to provide free-standing support for the MRS when it is detached from the TV.		
Verification: The Government will verify by testing that the MRS is equipped with a means to provide support for the MRS when it is detached from the TV.		
Notes: None		
Methodology	not in scope	**Scout Result**
1. Detach MRS from the TV. Record time and number of personnel it took to detach.		YES—Two personnel detached MRS from TV (HMMWV with MRIB) in 1 min 33 s. No tools required
2. Is MRS equipped with a means to provide support for the MRS when it is detached from the host vehicle?		YES—Required use of jack stands provided with MRS.

This section is discussed in Paragraph 3.5.3 of this report.

Table B- 10. Steering

Requirement: The MRS shall be steered separately from the TV.		
Verification: The Government will verify by testing that the MRS can be controlled or steered separately from the TV.		
Notes: Slack management will be tested during this test—it will be documented by taking photographs.		
Methodology	not in scope	**Scout Result**
1. While MRS is attached to the TV, inspect for a dedicated MRS controller or steering interface.		Not Applicable—The Scout configuration does not steer.
2. Can the MRS be controlled or steered separately from the TV?		Not Applicable—The Scout configuration does not steer.

This test is discussed in Paragraph 3.5.4 of this report.

Table B- 11. Steering Lockout

Requirement: In the case of a catastrophic failure of the MRS steering system, the MRS shall provide the ability to lock the roller in a fixed straight ahead position while remaining maneuverable enough to still operate safely, albeit with a reduced capability.		
Verification: The Government will verify by testing that in the case of a catastrophic failure of the MRS steering system, the MRS has the ability to lock the roller in a fixed straight ahead position while remaining maneuverable enough to still operate safely, albeit with a reduced capability.		
Notes: This test requires disabling the hydraulic system of the MRS. This test should be delayed until the end of MRS testing.		
Methodology	not in scope	**Scout Result**
1. Steer the MRS to the right or left. Disable hydraulics to simulate control/hydraulics failure.		Not Applicable—The Scout configuration does not steer.
2. Backup the TV to straighten out the MRS. Install the steering lockout mechanism. Measure lockout angle relative to straight position.		Not Applicable—The Scout configuration does not steer.
3. List any special tools required to install the steering lockout mechanism.		Not Applicable—The Scout configuration does not steer.
4. Does MRS have the ability to lock the roller in a fixed position?		Not Applicable—The Scout configuration does not steer.
5. While the MRS steering is locked out, operate the vehicle to check maneuverability. Is the vehicle maneuverable enough to still operate safely, even if its capability is reduced?		Not Applicable—The Scout configuration does not steer.
6. Has the Steering Lockout requirement been satisfied?		Not Applicable—The Scout configuration does not steer.

This section is discussed in Paragraph 3.5.5 of this report. This test was conducted only on the PC GEN III 5x5 MRS.

Table B- 12. Driving Lights

Requirement: The MRS shall contain driving lights (both IR and white) that provide sufficient light to allow the operator to operate the MRS safely during night operations.		
Verification: The Government will verify by inspection that the MRS contains driving lights (both IR and white). The Government will verify by testing that the MRS driving lights function properly and provide sufficient light to allow the operator to operate the MRS safely during night conditions.		
Notes: Prior to testing, allow sufficient time for the lights to warm up.		
Special Test Support Resources: Night vision equipment for test personnel/vehicle crew.		
Methodology	not in scope	**Scout Result**
1. Inspect for operational driving white lights.		YES—four white lights
2. Inspect for operational driving IR lights.	YES—two IR lights	
3. Develop a base line light spread pattern for white lights and photograph.	Beams on all white lights directed straight ahead and level.	
4. Determine the maximum visible distance that a target can be spotted from the white lights and record.	not in scope	Subject in dark cloths—365 ft Subject in light cloths—769 ft
5. In night conditions, qualitatively test driving white lights functions. Do white lights provide sufficient light to allow the operator to operate the MRS safely during night conditions?	YES—<35 mph	
6. Develop a base line light spread pattern for IR lights and photograph.	Beams on both IR lights directed straight ahead and level.	
7. Determine the maximum visible distance that a target can be spotted from the IR lights and record.	Edge of IR beam at 334 ft	Edge of IR beam at 283 ft.
8. In night conditions, qualitatively test driving IR lights functions (vehicle crew to use night vision equipment). Do IR provide sufficient light to allow the operator to operate the MRS safely during night conditions?	YES—<35 MPH	
9. Has the Driving Lights requirement been satisfied?	not in scope	YES

This section is discussed in Paragraph 3.5.6 of this report and *PC GEN III WW5 MRS Ballistics Test Report*.

Table B- 13. Blast Protection

Requirement: The MRS shall incorporate design features to minimize the effects of the explosive blast overpressure and fragmentation to the TV and its crew.		
Verification: The Government will verify by inspection that the MRS incorporates design features that minimize the effects of the explosive blast overpressure and fragmentation to the TV and its crew.		
Notes: Testing by analysis and inspection after ballistic testing.		
Methodology	not in scope	**Scout Result**
1. Conduct ballistic test IAW Mine Roller Blast Restraint Kit Ballistics test Plan dated 12 March 2010.	YES—Reference *PC GEN III WW5 MRS Ballistics Test Report*, 07 July 2010.	
2. Based on the results of the above, has the Blast Protection requirement been satisfied?	YES—Reference *PC GEN III WW5 MRS Ballistics Test Report*, 07 July 2010.	

This test is discussed in Paragraph 3.5.7 of this report.

Table B- 14. Mechanical Protection

Requirement: The MRS shall incorporate design features (such as mud/rock guards) to prevent rocks and debris from being thrown or propelled back toward TV during use.	
Verification: The Government will verify by inspection that the MRS incorporates design features (such as mud/rock guards) to prevent rocks and debris from being thrown or propelled back toward TV during us. The Government will verify by testing that this MRS design feature prevents rocks and debris from being thrown or propelled back toward TV during use.	
Notes: ▪ The test team will pick muddy, rocky, sandy, secondary roads and primary roads terrain for this test. ▪ Cable slack management will be tested during this test—it will be documented by taking photographs.	
Methodology	not in scope **Scout Result**
1. Inspect the MRS for design features (such as mud/rock guards) to prevent rocks and debris from being thrown or propelled toward TV during use.	Mud guards present on forward wheel banks
2. Drive the TV/MRS system in muddy terrain at suitable speeds (up to 25 mph in 5-mph increments). Does the MRS mechanical protection design feature prevent rocks and debris from being thrown or propelled toward TV during use?	YES—Mud guards provide full protection from road debris up to 25 mph. Some mud spray on TV wind shield between 15–25 mph.
3. Drive the TV/MRS system in rocky terrain at suitable speeds (up to 25 mph in 5-mph increments). Does the MRS mechanical protection design feature prevent rocks and debris from being thrown or propelled toward TV during use?	YES—Mud guards provide full protection from rocky road debris even above the recommended TV speed (tested to 45 mph)
4. Drive the TV/MRS system in sandy terrain at suitable speeds (up to 25 mph in 5 mph increments). Does the MRS mechanical protection design feature prevent rocks and debris from being thrown or propelled toward TV during use?	YES—Mud guards provide full protection from sandy road debris even above the recommended TV speed (tested to 45 mph)

Table B-14. Mechanical Protection- continued

Requirement: The MRS shall incorporate design features (such as mud/rock guards) to prevent rocks and debris from being thrown or propelled back toward TV during use.		
Methodology	not in scope	**Scout Result**
5. Drive the TV/MRS system in secondary road terrain at suitable speeds (up to 45 mph in 5-mph increments). Does the MRS mechanical protection design feature prevent rocks and debris from being thrown or propelled toward TV during use?	YES—Mud guards provide full protection from all road debris found on secondary (hard packed clay) roads up to 45 mph.	
6. Drive the TV/MRS system in primary road terrain at suitable speeds (up to 45 mph in 5-mph increments). If available, wet pavement and create puddles. Does the MRS mechanical protection design feature prevent rocks and debris from being thrown or propelled toward TV during use?	YES—Mud guards provide full protection from all road debris found on primary (paved) roads up to 45 mph. Some water spray at speeds >25, but easily removed by TV wiper system.	
7. Drive the TV/MRS system in reverse at ~5 mph. Does the debris, water, or MRS' mud-flaps impede reverse motion?	not in scope	NO
8. Has the Mechanical Protection requirement been satisfied?		YES

This test is discussed in Paragraph 3.5.8 of this report.

Table B- 15. Color

Requirement: ▪ External steel components of the MRS shall be Desert Tan, Number 33446 of FED-STD-595 and be compatible with MIL-DTL-53039C (19-Feb-2009), Coating, Aliphatic Polyurethane, Single Component, Chemical Agent Resistant. ▪ Surface preparation, quality assurance and application of all Chemical Agent Resistant Coating (CARC) shall be done IAW MIL-DTL 53072. ▪ The following items shall not be painted: terminal wiring connections, instruction diagrams and plates, instrumentation, rubber, lubrication fittings, hoses, nozzles, insulation material and all other parts whose operation of function would be adversely affected by paint.		
Verification: ▪ The Government will verify by inspection that the color of MRS external steel components are Desert Tan, Number 33446 of FED-STD-595, and the following items are not painted: terminal wiring connections, instruction diagrams and plates, instrumentation, rubber, lubrication fittings, hoses, nozzles, insulation material and all other parts whose operation of function would be adversely affected by paint. ▪ The Government will verify by analysis that surface preparation, quality assurance and application of all CARC coatings is done IAW MIL-DTL 53072.		
Notes: Certificate of conformance is acceptable for verification.		
Methodology	not in scope	**Scout Result**
1. Verify MRS external components are Desert Tan, Color 33446 per FED-STD-595.		YES
2. Verify Chemical Agent Resistant Coating (CARC) was applied IAW MIL-DTL 53072.	The MRSs tested during GVT did not have CARC coating. Proper procedures for surface preparation, quality assurance and application of CARC coatings were found on MRS drawing documentation, and were in conformance with MIL-DTL 53072.	

Table B-15. Color (continued)

Methodology	not in scope	Scout Result
3.Verify following areas not painted: - terminal wiring connections - instruction diagrams and plates - instrumentation - rubber parts - hoses - lubrication fittings - insulation material - any other part whose operation or function would be adversely affected by paint	None of these areas were painted	
4. Inspect MRS periodically to assess durability of paint.	YES—No degradation in paint system.	
5. Has the Color requirement been satisfied?	YES	

This test is discussed in Paragraph 3.5.9 of this report.

Table B-16. Watertight

Requirement: All critical electrical and hydraulic components of the MRS exposed to the operating environment (internal and external) shall be waterproof to the extent necessary to not degrade the MRS or TV capabilities.		
Verification: The Government will verify by inspection and testing that all critical electrical and hydraulic MRS components exposed to the operating environment are waterproof.		
Notes: Perform in conjunction with Fording requirement (5.2.25).		
Methodology	not in scope	**Scout Result**
1. Conduct Fording requirement test (5.2.25).		Yes—submerged to top of Roller Frame (42 in.).
2. Inspect that all MRS components exposed to the operating environment are waterproof. Is requirement satisfied?		No moisture in electrical box. All lights function after fording. No detriment to MRS proper function. Requirement is satisfied.

This test is discussed in Paragraph 3.5.10 of this report.

Table B- 17. Fording

Requirement: The MRS shall be capable of operation without degradation of functions in water to a depth of 30 in. (T) to 60 in. (O), without preparation or use of fording aids.		
Verification: The Government will verify by inspection and testing that the MRS is capable of operation without degradation of functions in water to a maximum depth of 30 in. (T) to 60 in. (O), without preparation or the use of fording aids.		
Notes: Perform in conjunction with Waterproof requirement (5.2.24).		
Methodology	not in scope	**Scout Result**
1. Ford water obstacle with MRS at test range.		Yes—submerged to top of Roller Frame (42 in.).
2. Inspect that all MRS components exposed to the operating environment are waterproof and operating within normal limits. Is requirement satisfied?		No moisture in electrical box. All lights function after fording. No detriment to MRS proper function. Requirement is satisfied.

This test is discussed in Paragraph 3.5.11 of this report.

Table B- 18. Human Factors

Requirement: The MRS shall be designed consistent with criteria for human systems integration and ergonomics using MIL-STD-1472F. Cables shall be labeled and easy to connect/disconnect. Visual indicators and messages shall be easy to read in all light conditions. Controls and displays shall be easy to locate and operate with minimal risk of error.		
Verification: ▪ The Government will verify by inspection that the MRS is designed consistent with criteria for human systems integration and ergonomics using MIL-STD-1472F. ▪ The Government will verify by inspection that the MRS cables are labeled and easy to connect/disconnect. ▪ The Government will verify by inspection that visual indicators and messages on the MRS are easy to read in all light conditions and that controls and displays are easy to locate and operate with minimal risk of error.		
Notes: None.		
Special Test Support Resources: ▪ None.		
Methodology	not in scope	**Scout Result**
1. Verify MRS cables are labeled and easy to connect/disconnect.	YES—Color Coded; Twist-lock	
2. Verify visual indicators and messages on MRS are easy to read in all light conditions.	YES—Light switch and hydraulic slew control are simple and intuitive.	
3. Verify controls and displays are easy to locate and operate with minimal risk of error.	not in scope	YES—Light switch simple and intuitive; labeled.
4. Designed consistent with criteria for human systems integration and ergonomics using MIL-STD-1472F?	Not Evaluated	
5. Any critical lifting issues?	not in scope	Assembly process requires forklift. Mud Guard Weight Brackets require two-man lift when de-palletizing. No lifting issue during TV attachment or detachment.
6. Has the Human Factors requirement been satisfied?	YES (with # 4 exception)	

This test is discussed in Paragraph 3.5.12 of this report.

Table B- 19. Safety

Requirement: Hazards of the MRS shall be identified and listed consistent with the methodology described in MIL-STD-882D. All high and serious hazards associated with the MRS shall be mitigated.		
Verification: The Government will verify by inspection that hazards of the MRS have been identified and listed consistent with the methodology described in MIL-STD-882D. The Government will verify by inspection that all MRS high and serious hazards have been mitigated.		
Notes: The *Panama City Generation III Mine Roller System Safety Assessment Report* can be used to verify this requirement**.**		
Methodology	not in scope	**Scout Result**
1. Inspect and identify that the hazards of the MRS are consistent with the methodology described in MIL-STD-882D.	YES—Reference *PC GEN III MRS Safety Assessment Report*, 09 Dec 2009.	
2. Conduct electrical safety assessment of MRS grounding, wiring, and fuses for compatibility with all host vehicles.	MRS grounding, wiring, and fuses for compatible with MTVR/HMMWV.	
3. Conduct mechanical safety assessment of hydraulic system (pressure relieve valves, generic caps, etc.)	not in scope	Not Applicable—The Scout configuration does not have hydraulics.
4. Inspect for marker flags.	Two marker flags present.	
5. Mitigate all high and serious hazards.		
6. Inspect that all MRS high and serious hazards have been mitigated.	No serious safety hazards noted.	
7. Has the Safety requirement been satisfied?	not in scope	YES

This test is discussed in Paragraph 3.5.13 of this report.

Table B-20. Common Tools and Parts

Requirement: Attachment and detachment of the MRS to the TV shall be accomplished to the maximum extent possible by utilizing common tools available in the U.S. military supply system, and shall not require more than two personnel (exclusive of vehicle driver). Any special tools shall be provided with the MRS.		
Verification: ▪ The Government will verify by testing that attachment and detachment of the MRS to the TV is accomplished utilizing common tools. ▪ The Government will verify by inspection that any special tools are provided with the MRS.		
Notes: This requirement will be satisfied in conjunction with the Attachment requirements (5.2.16 and 5.2.51).		
Special Test Support Resources: None.		
Methodology	not in scope	**Scout Result**
1. List tools and support equipment provided with the MRS.	Grease Gun	
2. Verify stowage location of all tools and support equipment.	Not Applicable	
3. Verify that during Attachment of the MRS to the TV only common tools and only special tools provided with the MRS were used for successful attach.	No tools required. A hammer may be needed if Hitch Pins bind.	
4. Tools required to install MRIB or Towing Bracket.	Two 2 ¼-in. wrenches	

This test is discussed in Paragraph 3.5.14 of this report. This test was conducted only on the PC GEN III 5x5 MRS.

Table B- 21. Electromagnetic Environment

Requirement: The MRS shall not degrade TV capability to operate in its intended operational electromagnetic environment. Emissions radiating from the MRS shall be within the limits of MIL-STD-461F, RE102 and RS103, Army Ground Systems.		
Verification: ▪ The Government will verify by inspection that electrical components and harnesses of the MRS are fabricated using bonding, shielding, and grounding techniques necessary for the MRS to operate in the Tactical Vehicle's intended EME. ▪ The Government will verify by testing that emissions radiating from the MRS are within the limits of MIL-STD-461F RE 102, and that the radiated susceptibility of the MRS is within the limits of MIL-STD 461F RS103 for Army Ground Systems		
Notes: EME test will be separate follow on test event.		
Special Test Support Resources: Testing inside an anechoic chamber located at J-PRIMES Laboratory (Eglin AFB, FL).		
Methodology	not in scope	**Scout Result**
1. Verify by analysis that electrical components and harnesses of the MRS are fabricated using bonding, shielding, and grounding techniques necessary for the MRS to operate compatibly in its intended EME.	Yes	
2.. Verify that emissions radiating from the MRS are within the limits of MIL-STD-461F RE102 for Army Ground Systems.	No—The MRS 5x5 hydraulic/electrical system components failed RE102 for Radiated Emissions. May not be applicable to Scout as it has no hydraulic pump.	
3. Verify that the radiated susceptibility of the MRS is within the limits of MIL-STD-461F RS103, Army Ground Systems.	Yes—The MRS 5x5 hydraulic / electrical system components passed RS103 Radiated Susceptibility.	
3. Has the EME requirement been satisfied?	Not fully	

This test discussed in paragraph 3.5.15 of this report.

Table B- 22. Workmanship

Requirement: For production items, finished items and parts shall not exhibit poor material and processing such as cracks, overspray, sharp edges, deformations, and missing operation which may affect serviceability, functioning, operations, appearance, or safety. Extraneous metal shall be removed from cast or forged parts. Hammering to shape, salvage operations (including repair by welding) or other similar practices shall not be permitted.		
Verification: The Government will verify by inspection that the MRS does not exhibit poor material and processing such as cracks, overspray, sharp edges, deformations, and missing operation which may affect serviceability, functioning, operations, appearance, or safety. Extraneous metal shall be removed from cast or forged parts. Hammering to shape, salvage operations (including repair by welding) or other similar practices shall not be permitted.		
Notes: None		
Special Test Support Resources: ▪ None.		
Methodology	not in scope	**Scout Result**
1. Inspect the MRS for workmanship (cracks, overspray, sharp edges, deformations, and missing operation which may affect serviceability, functioning, operations, appearance, or safety).	Workmanship Satisfactory. No cracks, sharp edges, or deformations visible. Paint system satisfactory with no over spray on cables or electrical/hydraulic fittings. Wiring and hydraulic lines are neatly installed. No hydraulic fluid leaks. Overall appearance clean and in good order.	
2. Has the Workmanship requirement been satisfied?	YES	

This test is discussed in Paragraph 3.5.16 of this report.

Table B- 23. Hydraulic System External Leakage and Cleanliness

Requirement: External hydraulic system leakage shall not exceed SAE J1176, class 3 for the production MRS under normal operation, and shall be limited to the hydraulic cylinders. No indication of external leakage shall be allowed from the hydraulic system components during the test of all new production MRS.		
Verification: The Government will verify by inspection and testing that the external hydraulic system leakage does not exceed SAE J1176, class 3 for the production MRS under normal operation, and is limited to the hydraulic cylinders.		
Notes: Inspect MRS for hydraulic leaks during daily Preventative Maintenance Checks and Services (PMCS) inspections.		
Methodology	not in scope	**Scout Result**
1. Inspect MRS for hydraulic leaks during daily PMCS inspections. Have any leaks exceeding SAE J1176, Class 3 been noted during testing?		Not Applicable—The Scout configuration does not have hydraulics.
2. Has the Hydraulic System External Leakage and Cleanliness requirement been satisfied?		Not Applicable—The Scout configuration does not have hydraulics.

This test is discussed in Paragraph 3.5.17 of this report. This test was conducted only on the PC GEN III 5x5 MRS.

Table B- 24. Reliability

Requirement: The MRS shall demonstrate an overall system reliability of 80% using a "typical" mission time of 8 h.		
Verification: The Government will verify by analysis and testing that the MRS has an overall system reliability of 80% using a "typical" mission time of 8 h.		
Notes: ▪ Note any reliability concerns throughout all testing. ▪ Record the times of any repair operations, from start to finish. ▪ Record the times of all system operating times from start to finish throughout testing.		
Methodology	not in scope	**Scout Result**
1. Perform 1,000-mi endurance test.	not in scope	
2. Record all operating times from start to finish during endurance test.	not in scope 6/16/100730–1630 239 mi 6/17/100800–1530 184 mi 6/21/100900–1530 178 mi 6/22/100900–1300 181 mi 6/23/100730–1545 73 mi 6/24/100715–1300 147 mi	
2. Record any repair event required and repair times from start to finish during endurance test.	No repair of MRS required during performance testing. No repair of MRS [redacted] required during 1,000-mi endurance test.	
3. Analyze MRS Endurance Test Operation Time Data Sheet(s) and Repair Tracking Data Sheet(s) and calculate overall system reliability.	Requires 6,000-mi endurance test. Not tested.	
4. Has the Reliability requirement been satisfied?	YES (with exception)	

This test is discussed in Paragraph 3.5.18 of this report.

Table B- 25. Maintainability

Requirement: ▪ Design provisions shall be made for servicing and replacement of all parts and components using only the Marine Corps General Mechanics Tool Kit, Automotive, (NSN 5180-00-606-3566). All access openings shall be in compliance with commercial practices and SAE J185. ▪ The maintainability standards in the Mean Time to Repair, Maximum Time to Repair, and Preventative Maintenance Checks and Services must be demonstrated.		
Verification: ▪ The Government will verify by analysis and testing that servicing and replacement of all MRS parts and components can be performed using only the Marine Corps General Mechanics Tool Kit, Automotive, (NSN 5180-00-606-3566). All access openings shall be in compliance with commercial practices and SAE J185. ▪ The Government will verify by inspection that the maintainability standards in the Mean Time to Repair, Maximum Time to Repair, and Preventative Maintenance Checks and Services were demonstrated.		
Notes: 1 No repairs required during GVT. Recommend 6,000 mile endurance test. 2 Daily inspection required 34-36 minutes to complete, exceeding the 20 minute requirement. The preventive maintenance inspection also took 36 minutes, well under the 2 hour requirement.		
Special Test Support Resources: ▪ None		
Methodology	not in scope	**Scout Result**
1. Inspect MRS serviceable and replaceable parts and components. Can these parts and components be serviced or replaced using only Marine Corps General Mechanics Tool Kit, Automotive, (NSN 5180-00-606-3566)?	YES	
2. Inspect access openings. Are access openings IAW SAE J185?	YES–Hydraulic/electrical systems easily accessible for repair. Grease fittings all accessible.	
3. Has the Mean Time to Repair requirement (5.2.35) been satisfied?	YES (with exception)[1]	
4. Has the Maximum Time to Repair requirement (5.2.36) been satisfied?	YES (with exception) [1]	
5. Has the Preventative Maintenance Checks and Services requirement (5.2.37) been satisfied?	YES (with exception) [2]	
6. Based on the above, has the Maintainability requirement been satisfied?	YES (with exceptions) [1, 2]	

This test is discussed in Paragraph 3.5.19 of this report. This test was conducted only on the PC GEN III 5x5 MRS.

Table B- 26. Mean Time to Repair (MTTR)

Requirement: Mean Time to Repair (MTTR) for all Essential Unscheduled Maintenance Demands (EUMD) must not exceed 1 h.		
Verification: The Government will verify by analysis and demonstration that the MTTR for all EUMD do not exceed 1 h. ▪ Record the times of any repair operations, from start to finish. ▪ Record the times of all system operating times from start to finish throughout testing.		
Notes: 1 No repairs required during GVT. Recommend 6,000 mile endurance test.		
Methodology	not in scope	**Scout Result**
1. Perform 1,000-mi endurance test and record all operating times from start to finish throughout testing.	Yes–on MRS not in scop 16-24 June 2010–1,002 mi. See not in scope	
2. Record any repair event required and repair times from start to finish during endurance test.	No repair of MRS required during performance testing. No repair of MRS not in scop required during 1,000-mi endurance test.	
3. Analyze MRS Endurance Test Repair Tracking Data Sheet(s) and calculate the MTTR for all EUMD.	Requires 6,000-mi endurance test. Not tested.	
4. Has the MTTR requirement been satisfied?	Yes (with exception) [1]	

This test is discussed in Paragraph 3.5.20 of this report. This test was conducted only on the PC GEN III 5x5 MRS.

Table B- 27. Corrective Maintenance Max Time to Repair

Requirement: Maximum Time to Repair for 90% of all EUMD (MAXTTR 90) must not exceed 2 h.		
Verification: The Government will verify by analysis and demonstration that the MATTR 90 does not exceed 2 h. ▪ Record the times of any repair operations, from start to finish. ▪ Record the times of all system operating times from start to finish throughout testing.		
Notes: 1 No repairs required during GVT. Recommend 6,000 mile endurance test.		
Methodology	not in scope	**Scout Result**
1. Perform 1,000-mi endurance test and record all operating times from start to finish throughout testing.	Yes- on MRS not in scope -24 June 2010–1,002 mi.	
2. Record any repair event required and repair times from start to finish during endurance test.	No repair of MRS required during performance testing. No repair of MRS not in scop required during 1,000-mi endurance test.	
3. Analyze MRS Endurance Test Repair Tracking Data Sheet(s) and calculate the MAXTTR for all EUMD.	Requires 6,000-mi endurance test. Not tested.	
4. Has the MAXTTR 90 requirement been satisfied?	YES (with exception) [1]	

This test is discussed in Paragraph 3.5.21 of this report.

Table B-28. Preventive Maintenance Checks and Services (PMCS)

Requirement: ▪ A daily operator functional inspection, to be performed by the operator through the use of well defined checklists or similar performance standards, should take no more than 20 min. ▪ Preventive maintenance (PM) involving the systematic inspection of the MRS to ensure its continued readiness prior to operation shall be performed weekly in a mean time of less than 2 h. PM shall include the use of PM checklists. These shall address such procedures for obtaining access to subassemblies and subcomponents, and inspection procedures for parts that deteriorate due to cycles of use, age, or climatic conditions.			
Verification: ▪ The Government will verify by demonstration that the daily operator functional inspection, to be performed by the operator through the use of well defined checklists or similar performance standards, does not exceed 20 min. ▪ The Government will verify by demonstration that the Preventive Maintenance (PM) involving the systematic inspection of the MRS to ensure its continued readiness prior to operation does not exceed 2 h. ▪ The Government will verify by inspection that the PM includes the use of PM checklists.			
Notes: 1 Daily inspection required 34-36 minutes to complete, exceeding the 20 minute requirement. The preventive maintenance inspection also took 36 minutes, well under the 2 hour requirement.			
Methodology	not in scope	**Scout Result**	**All Systems Pass/Fail**
1. Conduct daily operator functional inspection and record time to complete.	YES—Using not in scope Mine Roller Pre/Post Mission Check Card from Field Installation Manual. 34–36 Minutes Required.		Fail >20 min
2. Perform PM involving the systematic inspection of the MRS to ensure its continued readiness prior to operation and record time to complete.	YES—Using not in scope Mine Roller Pre/Post Mission Check Card from Field Installation Manual. 34–36 Minutes Required.		
3. Are PM checklists used for PM?	YES		
4. Has the PMCS requirement been satisfied?	YES (with exception) [1]		

This test is discussed in Paragraph 3.5.22 of this report.

Table B-29. Environmental Compliance

Requirement: ▪ The MRS shall conform to Environmental Protection Agency (EPA) requirements in effect at the time of production. ▪ Hazardous materials such as asbestos, beryllium, radioactive materials, hexavalent chromium (electroplating and coatings), cadmium (electroplating), mercury, or other highly toxic or carcinogenic materials (as defined in 29 CFR 1910.1200) with the exception of CARC, shall not be used in the manufacture, assembly, maintenance, or sustainment of the MRS without prior approval from the government. ▪ Class I and Class II Ozone Depleting Substances shall not be used. ▪ Lead shall not be used without prior approval of the Government. The use of lead solder may be approved for electrical components where a suitable alternative is not available. Lead-acid batteries may be used without approval from the Government. ▪ These requirements shall apply to any components/parts purchased through a subcontractor/vendor or Original Equipment Manufacturer (OEM) parts, as well as manufactured parts.		
Verification: ▪ The Government will verify by analysis that the MRS conforms to EPA requirements in effect at the time of production. ▪ The Government will verify by analysis that hazardous materials such as asbestos, beryllium, radioactive materials, hexavalent chromium (electroplating and coatings), cadmium (electroplating), mercury, or other highly toxic or carcinogenic materials (as defined in 29 CFR 1910.1200) with the exception of CARC, were not be used in the manufacture, assembly, maintenance, or sustainment of the MRS without prior approval from the government. ▪ The Government will verify by analysis that Class I and Class II Ozone Depleting Substances were not used. ▪ The Government will verify by analysis that lead was not used without prior approval of the Government.		
Notes: ▪ The use of lead solder may be approved for electrical components where a suitable alternative is not available. ▪ Lead-acid batteries may be used without approval from the Government. ▪ The *Panama City Generation III Mine Roller System Safety Assessment Report* includes MSDS information that may be used to partially verify this requirement.		
Methodology	not in scope	**Scout Result**
1. Inspect system drawings, certificate of conformance, or technical specification for all parts for material and process suitability.	Some lead solder used in electronic connections. No other hazardous materials or ozone depleting substances used.	
2. Inspect MSDS for all parts for compliance with hazardous materials requirement.	MSDS provided for Hydraulic Oil, Molybdenum Disulfide Grease, Lockite Adhesive, and Lithoplex Grease.	
3. Has the Environmental requirement been satisfied?	YES	

This test is discussed in Paragraph 3.5.23 of this report.

Table B- 30. Towing

Requirement: ▪ When not significantly damaged (e.g., missing an entire wheel bank), the MRS shall be capable of being safely towed behind the TV on improved roads at speeds of at least 20 mph, for not less than 30 mi, without damage to the TV or MRS. ▪ The MRS shall be prepared for towing by the operator in not more than 15 min using only the vehicle onboard tools or no tools. ▪ The MRS shall be removed from the towing configuration by the operator in not more than 15 min.		
Verification: ▪ The Government will verify by testing that the MRS is capable of being safely towed behind the TV on improved roads at speeds of at least 20 mph, for not less than 30 mi, without damage to the TV or MRS. ▪ The Government will verify by testing that the MRS may be prepared for towing by the operator in not more than 15 min using only the vehicle onboard tools or no tools. ▪ The Government will verify by testing that the reverse may be accomplished by the operator in not more than 15 min.		
Notes: Perform in conjunction with Common Tools and Parts requirement (5.2.28).		
Special Test Support Resources: MRS Tow Bracket.		
Methodology	not in scope	**Scout Result**
1. Attach MRS to tow vehicle using the MRS Tow Bracket and record time to complete preparation for towing.		3 min 30 s
2. Were tools other than vehicle onboard tools used to prepare MRS for towing?	None Required	
3. Tow MRS at least 30 mi at no less than 20 mph.	34 mi at 30-45 mph	
4. Inspect MRS and tow vehicle for damage after towing. Is any damage noted?	not in scope	None
5. Remove the MRS from the tow vehicle and record time to complete.		2 min—one person, no tools required
6. Has the Towing requirement been satisfied?	YES	
NOTE: MTVR MRS Recovery Bracket—280 lb ~15 min to install on MTVR—~10 min to remove from MTVR Two 2 ¼-in. wrenches required		

This test is discussed in Paragraph 3.5.24 of this report.

Table B- 31. Slinging Provisions

Requirement: The MRS shall have slinging provisions conforming to MIL-STD-209 and MIL-STD-913. The provisions shall enable the MRS to be lifted by a crane. The slinging provisions shall enable the MRS to be externally transported by helicopter. The use of spreader bars is not permitted. Slinging provisions may also be used as tie-down provisions when appropriate.		
Verification: The Government will verify by analysis and demonstration that the MRS has slinging provisions conforming to MIL-STD-209 and MIL-STD-913.		
Notes: None		
Special Test Support Resources: Crane and lifting slings.		
Methodology	not in scope	**Scout Result**
1. Analyze lift point strengths through finite element analysis based on criteria found in MIL-STD-209.	YES—Reference not in *Mine Roller; Lifting And Tie-down Analysis* 27May2010	
2. Perform crane lift demonstration using MRS slinging provisions.	YES—Representative test performed *on* not in *. See NSWCPC Helicopter Sling Load Pre-Certification Test Report* dated 16 July 2009.	
3. Based on the above test, has the Slinging Provisions requirement been satisfied?	YES	
NOTE: MRS lift points the same for all configurations. Two on Front Modular Table; Two on Gen III Roller Frame. All are marked and adequate for sling lift.		

This test is discussed in Paragraph 3.5.25 of this report.

Table B- 32. Tie-down Provisions

Requirement: ▪ Tie-down provisions shall be provided for transportability by air, rail, commercial carrier, Maritime Prepositioning Shipping, commercial shipping, and the Marine Corps organic motor transport assets for the MRS, as a minimum. The MRS shall have four tie-down provisions conforming to the strength requirements of MIL-STD-209. ▪ The MRS shall meet the requirements for transportation aboard C-17, C-130, and C-5 air transport.		
Verification: ▪ The Government will verify by analysis and demonstration that tie-down provisions are provided for the MRS for transportability by air, rail, commercial carrier, Maritime Prepositioning Shipping, commercial shipping, and the Marine Corps organic motor transport assets for the MRS. The MRS shall have four tie-down provisions conforming to the strength requirements of MIL-STD-209. ▪ The Government will verify by analysis and demonstration that the MRS meets the requirements for transportation aboard C-17, C-130, and C-5 air transport.		
Notes: None		
Methodology	not in scope	**Scout Result**
1. Analyze tie-down provision design strengths through finite element analysis based on criteria found in MIL-STD-209.	YES—*Reference* not in *Mine Roller; Lifting And Tie-down Analysis*, 27 May 2010	
2. Demonstrate that MRS tie-downs provided can be used for transportability on commercial carrier and Marine Corps organic motor transport assets for the MRS.	Not attempted based on failed analysis.	
3. Has the tie-down Provisions requirement been satisfied?	NO—Tie-downs to be redesigned and corrected through ECP process.	
NOTE: MRS tie-down points the same for all configurations. MRS has six tie-down points; two on Modular Front Table; four on Gen III Roller Frame. All tie-down points are marked. MRS is disassembled and palletized (on two 7 ft x 8 ft pallets) for air transport.		

This test is discussed in Paragraph 3.5.26 of this report.

Table B-33. Identification and Marking

Requirement: Each MRS shall be furnished with an identification plate showing the manufacturer's model number, national stock number (NSN), serial number, date of manufacture, contractor's name, and contract number. Each MRS shall have a durable corrosion resistant, metallic data plate.		
Verification: ▪ The Government will verify by inspection that the MRS is furnished with an identification plate showing the manufacturer's model number, NSN, serial number, date of manufacture, contractor's name, and contract number. ▪ The Government will verify by inspection that the MRS has a durable corrosion resistant, metallic data plate.		
Notes: None		
Methodology	not in scope	**Scout Result**
1. Inspect that MRS identification plate is a durable corrosion resistant, metallic data plate.	YES - metal	
2. Inspect MRS identification plate for manufacturer's model number, NSN, serial number, date of manufacture, contractor's name, and contract number.	YES—ID plate on Roller Frame. Contains manufacturer's model number, NSN, serial number, date of manufacture, contractor's name, and contract number. Serial number of Roller Frame stenciled on Modular Front Table. Part numbers stamped on most parts.	
3. Has the Identification and Marking requirement been verified?	YES	

This test is discussed in Paragraph 3.5.27 of this report.

Table B- 34. Padeyes: Towing, Slinging and Tie-down Markings

Requirement: All suitable towing, slinging, and tie-down locations shall be marked.		
Verification: The Government will verify by inspection that all suitable towing, slinging, and tie-down locations are marked on the MRS.		
Notes: None.		
Methodology	not in scope	**Scout Result**
1. Inspect that all towing, slinging, and tie-down locations are marked on the MRS assembly.	2 towing (marked “TOWING”) 4 slinging (marked “LIFT”) 6 tie-down (marked “NO LIFT”)	
2. Has the marking requirement for the MRS assembly been verified?	YES	

This test is discussed in Paragraph 3.5.28 of this report.

Table B-35. Unique Identification Markings

Requirement: ▪ The MRS shall include specific UID marking, as defined in MIL-STD-130. The two-dimensional UID marking shall be incorporated in data plates, shall be machine-readable with common optical scanning devices and be accompanied by the corresponding human readable markings when practical. ▪ All spare parts, secondary repairable items, items tracked by serial number, and consumables that exceed $5,000 when purchased separately shall also be marked with the UID.		
Verification: ▪ The Government will verify by inspection that the MRS includes specific UID marking, as defined in MIL-STD-130. ▪ The Government will verify by inspection that the two-dimensional UID marking is incorporated in data plates, is machine-readable with common optical scanning devices, and accompanied by the corresponding human readable markings when practical. ▪ The Government will verify by inspection that all spare parts, secondary repairable items, items tracked by serial number, and consumables that exceed $5,000 when purchased separately are marked with the UID.		
Notes: None.		
Methodology	not in scope	**Scout Result**
1. Is UID marking on MRS data plate IAW MIL-STD-130?	YES—UID on metal name plate.	
2. Do all spare parts, secondary repairable items, items tracked by serial number, and consumables that exceed $5,000 when purchased separately marked with UID IAW MIL-STD-130?	NO—not required	
3. Has the UID Marking requirement been verified?	YES	

B.5 Performance

This test is discussed in Paragraph 3.6.1 of this report.

Table B-36. Probability of Mine Initiation

Requirement: ▪ The probability that a VS1.6 anti-tank mine, or equivalent U.S. anti-tank mine such as M20 or M15, is initiated by the MRS when attached to the front of a TV. Mine initiation shall be performed against the specified threat employed using standard surface and subsurface emplacement methods identified in current doctrine (i.e., FM 5-34 or equivalent reference documentation). Mine initiation shall be achieved while traversing improved and unimproved road surfaces at clearance speeds of 5 mph on unimproved roads and 20 mph on improved roads at threshold and objective values of 50% and 80%, respectively.		
Verification: ▪ The Government will verify by analysis and testing that the MRS is capable of mine initiation traversing improved and unimproved road surfaces at clearance speeds of 5 mph on unimproved roads and 20 mph on improved roads at threshold and objective values of 50% and 80%, respectively.		
Notes: ▪ Test per NSWCPC-PPIED-SOP-0001.		
Special Test Support Resources: ▪ Mine surrogate targets. ▪ Data acquisition devices for recording mine initiation events.		
Methodology	not in scope	**Scout Result**
1. Conduct mine initiation test IAW NSWCPC-PPIED-SOP-0001against surrogate targets (VS1.6, M20, M15, or equivalent) while traversing improved and unimproved road surfaces at clearance speeds of 5 mph on unimproved roads and 20 mph on improved roads. Record results.	Testing not completed.	
2. Use test documentation to verify by analysis the Probability of Mine Initiation requirement. Has this requirement been satisfied?	Testing not completed.	

This test is discussed in Paragraph 3.6.2 of this report.

Table B-37. Demonstration of VOIED Initiation

Requirement: The demonstration of VOIED initiation by the Mine Roller when attached to the front of a TV. VOIED initiation shall be performed against the specified threat employed using documented surface and subsurface emplacement methods identified in current intelligence from National Ground Intelligence Center (NGIC) and Marine Corps Intelligence Activity (MCIA). Test procedures are available in the Standard Operating Procedures (NSWCPCD-PPIED-SOP-0001). VOIED initiation shall be achieved while traversing unimproved road surfaces at clearance speeds of 5 mph (T) to 10 mph (O). VOIED initiation shall be achieved while traversing improved road surfaces at clearance speeds of 20 mph (T) to 25 mph (O).		
Verification: The Government will verify by analysis, demonstration, or testing that the MRS is capable if VOIED initiation, as specified above.		
Notes: ▪ Use existing MRS test documentation to validate the Demonstration of VOIED Initiation requirement by inspection and analysis. ▪ Test per NSWCPCD-PPIED-SOP-0001.		
Methodology	not in scope	**Scout Result**
1. Conduct VOIED initiation test IAW NSWCPCD-PPIED-SOP-0001 against surrogate targets while traversing unimproved road surfaces at clearance speeds of 5 mph to 10 mph and improved road surfaces at clearance speeds of 20 mph to 25 mph. Record results.	Conducted VOIED initiation test of three type pressure plate triggering devices buried in unimproved and improved roadway.	
2. Inspect test results to determine that the MRS is capable of initiating a pressure plate activated VOIED while attached to a TV traversing improved and unimproved road surfaces at normal convoy speeds. Has the VOIED Initiation requirement been satisfied?	Threshold (T): Yes Objective (O): Yes	

This test is discussed in Paragraph 3.6.3 of this report.

Table B-38. Road Surface Undulation

Requirement: ▪ The MRS shall compensate for undulations in the road surface and engage mines and VOIEDs that may be employed on the surface or in shallow (2-in.) depressions (T) up to a 4-in. depression (O) in the traveled lane.		
Verification: ▪ The Government will verify by inspection and testing that the MRS compensates for undulations in the road surface and engages mines and VOIEDs that are employed in shallow (2-in.) and 4-in. depressions in the traveled lane.		
Notes: ▪ This test will be conducted with conjunction of VOIED Initiation requirement (5.2.45) test.		
Special Test Support Resources: ▪ Road surface with undulations of 2-in. depressions (T) up to a 4-in. depression (O) deep.		
Methodology	not in scope	**Scout Result**
1. Operate MRS/TV system on a road surface with undulations. Observe MRS performance—specifically MRS' tires ability to "hug" the road.	MRS maintains contact (hugs) with road surface	
2. Inspect contractor provided documentation indicating that the MRS is capable of engaging mines and VOIEDs that are employed in shallow (4-in.) depressions in the traveled lane.	**Mines:** Threshold (T) Not Tested Objective (O): Not Tested **VOIEDs:** Threshold (T) Not Tested Objective (O): Yes	

This test is discussed in Paragraph 3.6.4 of this report.

Table B-39. Area of Coverage

Requirement: The MRS shall clear a path equal to the track width of the TV (T) and up to the full width of the TV (O).		
Verification: The Government will verify by analysis, inspection, or testing that the MRS can clear a path equal to the track width of the TV (T) and up to the full width of the TV (O).		
Notes: None		
Special Test Support Resources: ▪ Solid Edge software and 3-dimensional solid model files of TV and MRS. ▪ Measuring tape.		
Methodology	not in scope	**Scout Result**
1. Measure and record the width (distance between the outer tread of outermost driver tire to outer tread of outermost a/driver tire) of the TV.		M1116 HMMWV 81 in.
2. Measure and record the width of the MRS (distance between the outer treads of outer tires).		118 in. max
3. Generate Solid Edge Model plots to help satisfy this requirement. Is the MRS wider than the widest TV?	YES—Reference Area Coverage Plots available upon request.	
4. Are the MRS tracks wider than the tracks of the widest TV?	not in scope	MRS track is wider than HMMWV track.
5. Has the Area of Coverage requirement been satisfied?	YES	

NOTES:

not in scope

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Scout

In a left-hand turn the max allowable steering (wheel) input is 45° (CCW) before the HMMWV left side track is exposed.

In a right-hand turn, the max allowable steering (wheel) input is 90° (CW) before the HMMWV right side track is exposed.

This test is discussed in Paragraph 3.6.5 of this report.

Table B-40. Clearance Speed

Requirement: ▪ The MRS shall operate properly and maintain performance requirements with the TV traveling at a speed of 5 mph (T) to 10 mph (O) on unimproved roads. ▪ The MRS shall operate properly and maintain performance requirements with the TV traveling at a speed of 20 mph (T) and 35 mph (O) on improved roads.		
Verification: ▪ The Government will verify by analysis, inspection, testing, or demonstration that the MRS operates properly with the TV traveling at clearance speeds of 5 mph (T) to 10 mph (O) on unimproved roads. ▪ The Government will verify by analysis, inspection, testing, or demonstration that the MRS operates properly with the TV traveling at clearance speeds of 20 mph (T) and 35 mph (O) on improved roads.		
Notes: ▪ This requirement may be tested in conjunction with the Mechanical Protection requirement (5.2.22). ▪ Do not continue to increase speed if the MRS or TV cannot be controlled or operated safely.		
Methodology	not in scope	**Scout Result**
1. Operate the MRS on unimproved road at speeds of up to 10 mph at 5 mph increments monitor full operation of MRS. Record all observed operational derogations.		YES—MRS able to operate properly on unimproved (sandy or clay) roads up to max recommended TV speed (tested to 45 mph)
2. Operate the MRS on improved road at speeds of up to 35 mph at 5 mph increments monitor full operation of MRS. Record all observed operational derogations.		YES—MRS able to operate properly on improved (hard packed clay or paved) roads up to max recommended TV speed (tested to 45 mph)
3. Has the Clearance Speed requirement been satisfied?	YES	

This test is discussed in Paragraph 3.6.6 of this report.

Table B-41. Transit Speed

Requirement: The MRS shall be capable of transiting with the TV traveling at a speed of 10 mph on unimproved roads, and 35 mph (T) up to maximum recommended speed of TV on improved roads.		
Verification: The Government will verify by inspection and testing that the MRS is capable of transiting with the TV traveling at a speed of 10 mph on unimproved roads, and 35 mph (T) up to maximum recommended speed of TV on improved roads.		
Notes: None.		
Methodology	not in scope	**Scout Result**
1. Operate the MRS on unimproved road at speeds of up to 10 mph at 5 mph increments monitor full operation of MRS. Record all observed operational derogations.		MRS able to transit up to 35 mph TV speed on unimproved (sandy or clay) roads.
2. Operate the MRS on improved road at speeds of up to 35 mph at 5 mph increments monitor full operation of MRS. Record all observed operational derogations.	YES—MRS able to transit to max recommended TV speed (tested to 45 mph) on improved (hard packed clay or paved) roads with wheel banks in center position.	
3. Has the Transit Speed requirement been satisfied?	YES	

This test is discussed in Paragraph 3.6.7 of this report.

Table B-42. Tactical Vehicle Degradation

Requirement: When attached to the front of the TV, the MRS shall not degrade the TV's operational mobility by more than 25% (O), 50% (T).		
Verification: The Government will verify by analysis, inspection, demonstration or testing that the MRS does not degrade the TV's operational mobility by more than 25% (O), 50% (T).		
Notes: ▪ To measure 90° turns a turning radius measurement will be taken of the host vehicle making the turn independently and with the MRS attached IAW NSWCPC-MRS-SOP-0002. ▪ Host vehicle with the MRS attached turning radius must not exceed independent host vehicle turning radius. ▪ Repeat test; three tests total. ▪ Slack management will be tested during this test—it will be documented by taking photographs.		
Methodology	not in scope	**Scout Result**
1. From a stop, perform a 90° right turn with independent TV. Measure turning radius.		47.8 ft maximum outer Curb-to-Curb at TV wheel # 1 28.6 ft minimum inner Curb-to-Curb at TV wheel # 4
2. From a stop, perform a 90° left turn with independent TV. Measure turning radius.		46.2 ft maximum outer Curb-to-Curb at TV wheel # 2 26.6 ft minimum inner Curb-to-Curb at TV wheel # 3
3. From a stop, perform a 90° right turn with the MRS attached to TV. Measure turning radius and compare to result from independent right turn.		66.2 ft maximum outer Curb-to-Curb at wheel # 1
4. From a stop, perform a 90° left turn with the MRS attached to TV. Measure turning radius and compare to result from independent left turn.		65.0 ft maximum outer Curb-to-Curb at wheel # 8

Table B-42. Tactical Vehicle Degradation (continued)

Methodology	not in scope	Scout Result
5. Compare Curb-to-Curb turn performance.		HMMWV/MRS requires 40% wider roadway over HMMWV to make right hand Curb-to-Curb turn, and 413% wider roadway for left hand Curb-to-Curb turn.
6. Perform T-Junction turning test IAW NSWCPC-MRS-SOP-0002.		HMMWV/MRS requires 46 % wider roadway over HMMWV to make the T-Junction turn.
7. Perform braking test IAW NSWCPC-MRS-SOP-0002 and record results in the data sheet in Section 5.2.57.		HMMWV/MRS requires 8-34 % greater distance to stop over HMMWV alone.
8. Perform Double lane change test IAW NSWCPC-MRS-SOP-0002 and record results in the data sheet in Section 5.2.58.		HMMWV/MRS requires 41% larger course to meet AVTP requirement.
9. Has the Tactical Vehicle Degradation requirement been satisfied?		YES

This test is discussed in Paragraph 3.6.8 of this report.

Table B-43. Attachment

Requirement: ▪ The MRS shall have the capability to be attached to the host vehicle without the aid of material handling equipment. ▪ The MRS shall have the capability to be attached to the TV without the aid of material handling equipment or special tools requiring no more than two personnel, excluding TV driver. Lifting and aligning devices organic to the MRS, such as jack stands, are permitted.		
Verification: ▪ The Government will verify by testing that the MRS has the capability to attach to the TV without the aid of material handling equipment or special tools ▪ The Government will verify by testing that the MRS has the capability to attach to the TV by no more than two personnel, excluding TV driver.		
Notes: The Attachment (5.2.16) and Common Tools and Parts (5.2.28) requirements must be satisfied to satisfy this Attachment requirement by deduction.		
Methodology	not in scope	**Scout Result**
1. Has the Attachment requirement been satisfied?		YES—Two personnel attached MRS to TV (HMMWV with MRIB) in 3 min 20 s. No tools required
2. Has the Common Tools and Parts requirement been satisfied?		YES—No tools required. A hammer may be needed of Hitch Pins bind. Jack stands provided with MRS are required.
3. Have both of the requirements in the two steps above been satisfied?		YES

This test is discussed in Paragraph 3.6.9 of this report.

Table B-44. Detachment

Requirement: ▪ The MRS shall have the capability to be detached from the host vehicle without the aid of material handling equipment or special tools. ▪ The MRS shall have the capability to be detached from the TV without the aid of material handling equipment or special tools requiring no more than two personnel, excluding TV driver.		
Verification: ▪ The Government will verify by testing that the MRS has the capability to be detached from the host vehicle without the aid of material handling equipment or special tools. ▪ The Government will verify by testing that the MRS has the capability to be detached from the TV without the aid of material handling equipment or special tools requiring no more than two personnel, excluding TV driver.		
Notes: The Detachment requirement (5.2.17) has to be satisfied to satisfy this Detachment requirement by deduction.		
Methodology	not in scope	**Scout Result**
1. Has the Detachment requirement been satisfied?		YES—Two personnel detached MRS from TV (HMMWV with MRIB) in 1 min 33 s. No tools required
2. Was this detachment performed without the aid of material handling equipment or special tools?		YES—For detachment, the MRS Scout configuration requires the use of the jack stands provided with the MRS.
3. The results of the above two steps have to be positive to satisfy this requirement. Has the Detachment requirement been satisfied?		YES